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# GREEK MEDICINE IN ITS RELATION TO RELIGION AND MAGIC

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In the historiography of Greek medicine religious and magical healing, in general, are dealt with only occasionally and very briefly. No one will deny that, throughout antiquity, incubations played an important rôle, nor will it be disputed that incantations, at least in later centuries, were of great importance. But since these are factors abhorrent to modern science, they are not interesting to the modern historian either.

The neglect of religious and magical medicine seems the more justifiable because, according to the prevailing opinion, Greek medical art itself dispensed with religion and magic. Traces of these, if they are to be found in any period at all, soon became "rather of the drapery than of the body of medicine." [1] Religious cures, "the half-world" [2] of scientific medicine, and magical rites, its superstitious caricature—so to speak—are said to have been rejected by the Greek physicians themselves. The abrogation of religious and magical thought is therefore considered even as characteristic of the Greek attitude and as significant for the difference between it and

* I wish to express my gratitude to Mrs. H. Cherniss for revising my English.

[1] T. Clifford Allbutt, Greek Medicine in Rome, London, 1921, p. 31: "In Greece the theurgic invocations of Apollo Paean, of Chiron, of Aesculapius, seem soon to have become, as in the Oath, rather of the drapery than of the body of medicine."

[2] W. W. Tarn, Hellenistic Civilization, London, 1930, p. 272.

the Roman mode of thinking.[3] There is no need for more than a perfunctory consideration of those unscientific conceptions.

It is true, religion and magic are very seldom, almost never, mentioned in Greek medical treatises; if they occur, they are usually discussed in a negative sense. At first glance it seems, therefore, safe to conclude that they were of no importance, at least up to the time of Galen. Later, while Galen's rational medicine was still preserved in the encyclopedias, the new and prevailing spirit of medicine was that of religion and magic. But those centuries are called the decadence of ancient medicine. There is hardly another term used to describe this period, so strong is the conviction that scientific medicine cannot have anything in common with religious and magical forces.[4] Some scholars recognize the fact that religion and magic became apparent only in the Byzantine epoch but began to influence medicine long before Galen.[5] They date the decline earlier. According to them the rational treatment of Coan and Cnidian physicians was already contaminated in the 4th century B. C. For Hippocratic medicine did not outlive Platonic methods; from the Hellenistic era on it became speculative and even superstitious. Thus medicine, like all the other sciences, collapsed long before the close of antiquity.[6]

[3] T. Clifford Allbutt, l. c.: "In Rome, and not during the Republic only, theurgic, or hierurgic, or magical craft 'and those who used curious arts' were of the body of it; drugs and operations were but auxiliaries."

[4] H. O. Taylor, Greek Biology and Medicine (Our Debt to Greece and Rome), 1922, especially p. 122. Identical in its principle is the representation of the history of Greek medicine in Gercke-Norden, Einleitung in die Altertumswissenschaft, II, 5[4], Exakte Wissenschaften v. A. Rehm und K. Vogel, Leipzig, 1933. Cf. also U. v. Wilamowitz-Moellendorf, Die Griechische Literatur des Altertums (Die Kultur der Gegenwart, I, 8[8], 1912, p. 250). Ivan Bloch, Byzantinische Medizin (Handbuch der Geschichte der Medizin, herausgegeben v. M. Neuburger und J. Pagel, Jena, 1902, I, p. 508). A certain superiority of Greek medicine over the Roman is thereby acknowledged even for the latest centuries, cf. Gercke-Norden, l. c., p. 77 and M. Neuburger, Geschichte der Medizin, II, 1, 1911, p. 3. Cf. also S. Runciman, Byzantine Civilization, London, 1933, pp. 132; 237.

[5] M. Neuburger, l. c., pp. 3-4.

[6] W. H. S. Jones, Hippocrates, with an English translation (Loeb Classical Library), I, 1923, p. 8: "[In Greek medicine] the two methods, that of Greek philosophy and that of modern science, stand face to face. The struggle between them was, for the time being, short. Medicine, almost the only branch of Greek science scientifically studied, was worsted in the fight, and medical science gradually degenerated from rational treatment to wild speculation and even quackery and superstition. The transcendant genius of Plato, strong in that very power of per-

Now it is easy to argue that from a purely historical aspect these limitations and valuations cannot be accepted. Medicine, imbued with religion and magic or freed from both of them, medicine after Galen or in the Hellenistic period is, after all, Greek medicine; Greek medical literature is, indeed, an accumulation of the most different writings.[7] One must depict the facts as they are without any prejudice and properly determine the share which each of the different forms of treatment had in reality.

But this is not enough. There are not only "three lines of possible approach which may be described as the secular, the magical and the religious,"[8] each one of them of equal historical value, and each strictly separated from the others. That religious medicine at least changed a good deal by taking over results of scientific medicine, by becoming more rational, is a fact generally believed.[9] Yet an influence of religious and magical ideas on science is also conceivable. It can be denied only if it is true that the conception of medical art necessarily devoid of any religious and magical content was adopted by the ancient physicians. Whether this was generally

suasion the use of which he so much deprecated, won the day. The philosophic fervor which longed with passionate desire for unchangeable reality, that felt a lofty contempt for the material world with its ever-shifting phenomena, that aspired to rise to a heavenly region where changeless Ideas might be apprehended by pure intelligence purged from every bodily taint, was more than a match for the humble researches of men who wished to relieve human suffering by a patient study of those very phenomena that Plato held of no account. So for centuries philosophy flourished and science languished, in spite of Aristotle, Euclid and Archimedes." Withington in his contribution to W. H. S. Jones, Malaria and Greek History, Manchester, 1909, pp. 154 sq., expresses the same opinion, although he gives a different explanation.

[7] Charles Singer, Greek Biology and Greek Medicine, Oxford, 1922, p. 80-81, is quite right in stating: "That mass [of Greek medical learning] contained much dross, material that survived from early as from late Greek times which was hardly, if at all, superior to the debased compositions that circulated in the name of medicine in the middle centuries. The recovered Greek medical writings also contained some material of the purest and most scientific type."

[8] W. R. Halliday, The Treatment of Disease in Antiquity (in "Greek Poetry and Life," Essays presented to G. Murray, Oxford, 1936, p. 277). But he, too, calls Galen "the last Greek medical scientist of antiquity. Man's mind had moved from a scientific towards a religious and magical view of the universe." (p. 293).

[9] Cf. R. Herzog, Die Wunderheilungen von Epidaurus, Philologus, Supplement XXII, III, 1931, pp. 145-147; cf. also O. Weinreich, Antike Heilungswunder, Religionsgeschichtliche Versuche u. Vorarbeiten, VIII, 1, 1909, p. 110.

the case is not to be decided without further proof; the reticence concerning religion and magic, even their rejection in many cases, does not suffice as an argument. For these are ambiguous instances which have to be interpreted first. Such an inquiry is also important, since religious healing and magical rites used by patients throughout antiquity and relied on in ever-increasing measure, presented if not a theoretical, at least a practical problem to the physicians. Did the physicians recognize the practice of priests and magicians as a means outside their own activity or did they renounce it as being worthless and even false? Their reaction must have depended largely on their theoretical attitude towards religious and magical ideas.

These are the problems involved in the relation of Greek medicine to religion and magic. It is with their discussion and with the description of the historical situation that I shall try to deal, testing the character of Greek medicine in regard to the explanation and to the treatment of diseases. In doing this I cannot base my argument on any continuous ancient debate of the subject; no such book is preserved. It is necessary to rely on single phrases to be found in the different writings and to take them as a clue to the underlying general ideology. This is a laborious procedure. A vast material must be collected and the judgment must be always restricted and modified. But no other way is left for an approach to the problem which is so important for the adequate interpretation of Greek medicine.

## I

### The Explanation of Diseases

By the Hippocratic as well as by the later physicians, the causes of illnesses are held to be first of all the effect upon the human body of cold, warmth, sun, air, and climate. This, no doubt, is a natural explanation and to many physicians it means this and nothing more. A follower of Anaxagoras in the 5th century B. C., an Epicurean or Sceptic in the Hellenistic centuries and later, each considers the celestial phenomena as appearances of nature, devoid of God.[10]

But this, to be sure, is not the only, not even the most usual meaning expressed by those conceptions. The Hippocratic book on the

[10] Cf. the corresponding medical theories p. 206.

Sacred Disease states: "This disease . . . comes from the same causes as others, from the things that come to and go from the body, from cold, sun, and from the changing restlessness of winds. These things are divine, . . ." [11] Later, for physicians who follow Plato and Aristotle, the divinity of sun and stars and climate is unquestionable; nor are the forces of the lower world, air and water, deprived of divinity.[12] The Stoic physicians firmly believe in the divine character of the forces of nature. On the other hand, the interpretation of the gods as natural powers is very common and very Greek. Some declare that "the Phoenicians had better notions about the gods than the Greeks, giving as an instance that to Asclepius they assign Apollo as father, but no mortal woman as his mother. Asclepius . . . is air, bringing health to mankind and to all animals likewise; Apollo is the sun, and most rightly is he named the father of Asclepius, because the sun, by adapting his course to the seasons, imparts to the air its healthfulness." But the answer is that: "The argument was as much Greek as Phoenician; for at Titane in Sicyonia the same image is called both, Health and . . . thus clearly showing that it is the course of the sun that brings health to mankind." [13] All these instances reveal how utterly different are the ancients' conceptions of natural phenomena from those of modern times.

[11] Jones, l. c., II, p. 183: *Αὕτη δὲ ἡ νοῦσος . . . γίνεται ἀφ' ὧν καὶ αἱ λοιπαί, ἀπὸ τῶν προσιόντων καὶ ἀπιόντων, καὶ ψύχεος καὶ ἡλίου καὶ πνευμάτων μεταβαλλομένων τε καὶ οὐδέποτε ἀτρεμιζόντων. ταῦτα δ' ἐστὶ θεῖα, . . .*

[12] E. g., Plato, Laws, X, 899b; Aristotle, On the Heaven, 288a 4-5.

[13] Pausanias, Achaia, XXIII, 7 (Pausanias, Description of Greece, with an English Translation by W. H. S. Jones, Loeb Class. Library, III, 1918, p. 309): *. . . ὁ ἐγνωκέναι τὰ ἐς τὸ θεῖον ἔφασκε Φοίνικας τά τε ἄλλα Ἑλλήνων βέλτιον καὶ δὴ καὶ Ἀσκληπιῷ πατέρα μὲν σφᾶς Ἀπόλλωνα ἐπιφημίζειν, θνητὴν δὲ γυναῖκα οὐδεμίαν μητέρα. Ἀσκληπιὸν μὲν γὰρ ἀέρα γένει τε ἀνθρώπων εἶναι καὶ πᾶσιν ὁμοίως ζώοις ἐπιτήδειον πρὸς ὑγίειαν, Ἀπόλλωνα δὲ ἥλιον καὶ αὐτὸν ὀρθότατα Ἀσκληπιῷ πατέρα ἐπονομάζεσθαι, ὅτι ἐς τὸ ἁρμόζον ταῖς ὥραις ποιούμενος ὁ ἥλιος τὸν δρόμον μεταδίδωσι καὶ τῷ ἀέρι ὑγιείας . . . οὐδὲν δέ τι Φοινίκων μᾶλλον ἢ καὶ Ἑλλήνων ἔφην τὸν λόγον, ἐπεὶ καὶ ἐν Τιτάνῃ τῇ Σικυωνίων τὸ αὐτὸ ἄγαλμα Τγίειαν τε ὀνομάζεσθαι καὶ . . . δῆλα ὡς τὸν ἡλιακὸν δρόμον ἐπὶ γῆς ὑγίειαν ποιοῦντα ἀνθρώποις.* This opinion is the more important since Peripatos and Stoa had a conciliatory attitude toward common religion, the latter even trying to combine the popular belief with its philosophical theory. I am, however, only concerned with the problem of what Greek gods mean to the different periods and groups of men, not with the question of whether they were originally nature-gods or not.

If this is so, the adequate interpretation of the terminology used in Greek medicine becomes very difficult. In his book on the Sacred Disease the author employs nothing but the terms sun and cold and winds and no theological vocabulary whatsoever. It is only in the differentiation of his conception from that of the others that he refers to the elements as divine.[14] Were it not for reasons of polemics, then,—that he wants to make clear his position against those who declare special diseases to be divine—he would scarcely even mention his belief in the divinity of the elements. Thus, natural and religious expressions are used as equivalents.[15] Whether this is so or not, depends in every case on the philosophical and scientific outlook of the man who is writing.

As for dogmatic physicians of the Hellenistic schools the religious connotation of their words can safely be assumed. For they are more or less related to the Platonic, Aristotelian or Stoic philosophy. Only Empiricists and Methodists of those centuries can be said to think in purely natural terms. For they are followers of the new Academy or of the Pyrrhonean Scepsis. But what about the Hippocratic physicians whose philosophical standpoint is hardly known, what about the average physician who is a practitioner and not a trained scientist with a philosophical background?

The Hippocratic author, expressing his opinion that sun and cold and winds are divine, does not give any proof of his assumption. Apparently he is not concerned with objections which could be raised against such a belief. At first glance it seems to follow that he is making a statement generally accepted in his time. But no doubt, in the 5th and 4th centuries B. C., when this book and all the other Hippocratic writings were probably written, there were men who believed that the sun and moon and all the natural appearances are only corporeal bodies. To them the processes going on in the world are not influenced by God. This disbelief, as it is called by Plato,

[14] Cp. 1; cp. 22.

[15] Cf. Herodotus, II, ch. 24, where the author says in one statement (Herodotus, with an English Translation by A. D. Godley, Loeb Class. Library, I, 1926, p. 301, "During the winter the *sun* is driven by the storms from his customary course and passes over the inland parts of Libya. Now to make the shortest conclusion, that is all that need be said; for to whatever country this *God* is nearest, or over it, it is to be thought that that land is the thirstiest and that the rivers in it are diminished."

is widespread even in the 4th century B. C.[16] At the same time, however, the average Greek, asked whether God exists or not, truthfully asserts the existence of the gods. He points to the evidence of the earth, the sun, moon, and stars as instances of deity and divinity. Concerning all the celestial phenomena, concerning the years and months and all the seasons, he does not deny that "all things are full of gods," as Thales said. According to him nobody is foolish enough to disregard this belief.[17] In other words, the disbelief in the divinity of those powers of nature is restricted to a certain group of people, to the enlightened, but it is not at all self-evident nor is it the attitude of the average man. For this attitude is relatively new and rather suspicious: "The first man to put in writing the clearest and boldest of all doctrines (concerning the natural explanation of the phenomena) was Anaxagoras. But he was no ancient authority, nor was his doctrine in high repute. It was still under seal of secrecy, and made its way slowly among the few only, who received it with a certain caution rather than with implicit confidence. Men could not abide the natural philosophers and 'visionaries,' as they were then called, for that they reduced the divine agency down to irrational causes, blind forces, and necessary incidents." [18] The Hippo-

[16] Plato, Laws, X, 886e; Sophistes, 265c.

[17] Plato, Laws, X, 886a; d/e; 899b/c. It is remarkable that Plato says, whether in earnest or in jest, that these theories are familiar in Athens but unknown in Crete (886b). They are certainly in contrast to the old religious attitude. For "it seems the first men in Greece thought those only to be gods whom many of the barbarians honour to-day—sun, moon, earth, stars and heaven." *φαίνονταί μοι οἱ πρῶτοι τῶν περὶ τὴν Ἑλλάδα τούτους μόνους τοὺς θεοὺς ἡγεῖσθαι οὕσπερ νῦν πολλοὶ τῶν βαρβάρων, ἥλιον καὶ σελήνην καὶ γῆν καὶ ἄστρα καὶ οὐρανόν.* (Plato, Cratylus 397c).

[18] Plutarch, Nicias, ch. 23 (Plutarch's Lives, with an English Translation by Bernadotte Perrin, Loeb Class. Library, III, 1915, p. 291): *Ὁ γὰρ πρῶτος σαφέστατόν τε πάντων καὶ θαρραλεώτατον περὶ σελήνης . . . λόγον εἰς γραφὴν καταθέμενος Ἀναξαγόρας οὔτ' αὐτὸς ἦν παλαιὸς οὔτε ὁ λόγος ἔνδοξος, ἀλλ' ἀπόρρητος ἔτι καὶ δι' ὀλίγων καὶ μετ' εὐλαβείας τινὸς ἢ πίστεως βαδίζων. οὐ γὰρ ἠνείχοντο τοὺς φυσικοὺς καὶ μετεωρολέσχας τότε καλουμένους, ὡς εἰς αἰτίας ἀλόγους καὶ δυνάμεις ἀπρονοήτους καὶ κατηναγκασμένα πάθη διατρίβοντας τὸ θεῖον.* The possible forerunners of this disbelief are discussed very briefly, its novelty being stressed also in Plato's Laws, X, 886c/d. I am well aware that Aristophanes (Peace, v. 410 sq.) says the Greeks are given into the hands of the barbarians because they do not sacrifice to sun and moon. But it is quite a different problem whether sacrifices were made to these powers or whether these phenomena were considered to be divine at that time. And certainly Socrates, a contemporary of Aristophanes, did not want to investigate the meteorological phenomena, because they are *divine*, but was interested in *human* things alone, namely in ethical problems (Xenophon, Memorabilia, I. 1. 12).

cratic author is quite right, then; his conviction does not need any detailed proof. For it is still more usual to understand the natural powers as divine than as merely natural; the opposite theory is the one which, in general, has to be demonstrated. It is the philosopher who must ascertain the divine character of the world against those thinkers who disagree with such an opinion; the ordinary man may still speak of it as carrying its own evidence.

From this fact it follows, of course, that in the Hippocratic writings one cannot possibly interpret all the natural terms as devoid of any religious meaning. It is not necessary to dwell on the fact that it is from the book on the Sacred Disease that the statement about the divinity of the natural quality derives, from this very enlightened and critical treatise as it is usually called.[19] All the same, the assumption is justified. With the exception of a few books the Hippocratic writers in general do not renounce the divinity of nature, even if they do not mention it expressly. They are, apparently, not atheists, as they would have to be if they embraced the opposite theory.[20] Even less can it be assumed that the average physicians abandoned the old inherited belief in the divine character of sun and air and seasons. Their mental attitude was still nearer to that of the people who, unable to endure the atheistic philosophers, expelled them even from Athens,[21] and who were always suspicious of the natural explanation of phenomena if it excluded the recognition of divine power. It is true that "it was not until later times that the radiant repute of Plato, because of the life the man led, and because he subjected the compulsions of the physical world to divine and more sovereign

[19] Cf. e. g., U. v. Wilamowitz-Moellendorf, Griech. Lesebuch, I, 2, Text, Berlin, 1926, pp. 269-70: "Der aufgeklärte Arzt bekämpft die übernatürliche Natur der Krankheit . . . Aber nicht minder liegt dem Verfasser an der Einheitlichkeit der Naturauffassung, an der Wissenschaft, die auch für seine Beurteilung der Heiligen Krankheit massgebend ist." Cf. also Jones, l. c., II, p. 129.

[20] The merely natural explanation of the heavenly bodies was reason enough for calling the philosophers atheists (Plato, Laws, XII, 967c). Yet, as far as I can see, there is no proof for Heidel's assumption that the physicians also are named in antiquity a godless crew, certainly not because of their attacks against magicians (cf. Proceedings of the American Academy of Arts and Sciences, Vol. XLV, 1910, Footnote 47).

[21] Anaxagoras (Plutarch, Pericles ch. 32, The Law of Diopeithes); Protagoras (Sextus Empiricus, adv. mathematicos IX, 56); Diagoras (Aristophanes, Birds, v. 1073).

principles, took away the obloquy of such doctrines as these, and gave their science free course among all men." [22] For even in later centuries Epicureans were banished from the cities because of their atheism; throughout antiquity, the natural explanation of the world remained a bold venture. The average man recognized God's ways in the movements of heavenly bodies and so, ordinarily, did the physician.[23] It is evident then, that all the external influences which are held responsible for the origin of diseases are in general not understood as merely natural. Sun and moon and stars and seasons are material to the modern mind but to the ancients they are gods.

Now the question arises as to how the explanation of illnesses by inner factors, by the nature of man or of diseases, an explanation very common in antiquity too, must be interpreted. In answering it a certain difficulty, noticeable, I think, in the whole discussion of the subject of my inquiry, will become even more striking. The Greeks speak of nature as do the moderns. But what they mean by it, as what they mean by all their notions of natural phenomena, is different from the modern conceptions which in their definite form always arise in the modern mind at the mention of the terms.[23a] Nevertheless, only these words can be used; step by step the distinct features of the ancient thought must be described in these same terms. In order to avoid any misunderstanding of the statements, it is necessary therefore always to remain cognizant of this difference between ancient and modern terminology.

From the 5th century B. C. on nature was conceived as a mechanical or dynamic power of its own without any divine manifestation. It was defined in this way by the followers of the physiologists in the pre-Socratic centuries and in Plato's time. Strato thought that nature, without the help of the gods, creates everything. The Epicu-

[22] Plutarch, Nicias, ch. 23, l. c.: *ὀψὲ δ' ἡ Πλάτωνος ἐκλάψασα δόξα διὰ τὸν βίον τοῦ ἀνδρός, καὶ ὅτι ταῖς θείαις καὶ κυριωτέραις ἀρχαῖς ὑπέταξε τὰς φυσικὰς ἀνάγκας, ἀφεῖλε τὴν τῶν λόγων τούτων διαβολήν, καὶ τοῖς μαθήμασιν εἰς ἅπαντας ὁδὸν ἐνέβυκεν.*

[23] Cf. Jakob Burckhardt, Griech. Kulturgeschichte[4], III, pp. 324 sq.; II, p. 216, and Plato (Laws, X, 888b-e) who contends that nobody is able to continue in his disbelief "till old age."

[23a] Not to mention the various meanings which the conception of nature had for the Greeks themselves; this problem cannot be dealt with here, cf. Heidel, l. c., pp. 95 sq.

reans, although believing in the existence of God, did not let him take part in the worldly processes. In the Academic philosophy nature was considered to be the necessity of movement; it was just in regard to diseases that such a conception was worked out most clearly.[24] Physicians imbued with those doctrines, then, cannot but contemplate the nature of man as devoid of God. Among the Hippocratic writers a few undoubtedly share such an opinion, the same ones who do not believe in the divinity of the elements. And the later Empiricists and Methodists do not recognize the divine impress of God either.

But certain as this is, the opinion that nature cannot be thought otherwise than as created and permeated by God is also to be found throughout antiquity. So it is said in the book on Airs, Waters, and Places: "I too think that these diseases are divine, and so are all others, no one being more divine or more human than any other; all are alike, and all divine, but each of them has a nature of its own, and none arises without its nature." [25] To this man, the distinction between divine and human and the different estimation of these two powers become meaningless because everything is equally divine. This does not imply that God acts directly and is responsible, by reason of His personal interference, for the single event. Such a possibility is expressly excluded. The individual disease has a nature of its own, but by this term its divine character is only expressed in another form; it is not done away with by being explained through nature. Individual nature therefore, since it does not contradict God, but is rather His essence, must be apprehended as created by God and as divine in itself. This conviction is expressed also in the Hippocratic book on Regimen: "The nature of all things was arranged by the gods," and "all the things take place . . . through a divine necessity." [26] In the same way nature is thought of later.

[24] Concerning the physiologists cf. Plato, Laws, X, 889b; Sophistes 265c and Plutarch, De defectu oraculorum, 436d. Concerning Strato, cf. Cicero, Academica, II, 38, 121; De natura deorum, I, 13, 35; concerning the Academy cf. De natura deorum, III, 25, 65; 11, 27; 10, 24.

[25] Jones, l. c., I, p. 127 (slightly altered): *ἐμοὶ δὲ καὶ αὐτῷ δοκεῖ ταῦτα τὰ πάθεα θεῖα εἶναι καὶ τἄλλα πάντα καὶ οὐδὲν ἕτερον ἑτέρου θειότερον οὐδὲ ἀνθρωπινώτερον, ἀλλὰ πάντα ὁμοῖα καὶ πάντα θεῖα. ἕκαστον δὲ αὐτῶν ἔχει φύσιν τὴν ἑωυτοῦ καὶ οὐδὲν ἄνευ φύσιος γίνεται.*

[26] Jones, l. c., IV, pp. 249-51: *φύσιν δὲ πάντων θεοὶ διεκόσμησαν.* 237: *πάντα γίνεται δι' ἀνάγκην θείην.*

It is divine to the Platonic physician; to the Aristotelian physician it is at least demonic, the divine not being realized in an absolute degree.[27] The Stoic physician must find God everywhere in nature; for nature is identical with God; these are only different terms.[28] While there is a tendency to understand nature without referring to divine power, a more theological tendency also exists, nay even prevails, in antiquity.

This theological conception, however, seems to a certain extent self-contradictory. In the theory of the Hippocratic physicians rationalism and belief are interwoven with each other, naturalism and theology are combined into a unity; the same is valid for the ideas of the later physicians. Everything is natural, but in being so, it is divine too, or to use another phrase it is supernatural; and proof of this is found in reasoning. The modern logical objection to such a theory apparently did not occur to the ancient mind; indeed, there was no opposition between God and nature.[29] At any rate, it seems impossible to contend that every form of supernaturalism was rejected by the Hippocratic physicians. On the contrary, they as scientists embraced a supernatural dogma.[30] Equally unfounded, I believe, is the statement that the gods were not dethroned by these men, yet that nothing was left to them but "the sole rôle of first cause in the physical world."[31] God is indeed deprived of any direct

[27] Concerning Plato, cf. e. g., Sophistes 265c; concerning Aristotle, cf. E. Zeller, Die Philosophie d. Griechen, II, 2[4], 1879, pp. 330 sq.

[28] Cf. e. g., Diels, Doxographi Graeci, 322b9-12.

[29] One is reminded of the most significant metaphysical idea of the 17th century which is characterized by Dilthey as "Halbheit des rationalen Supranaturalismus; Kompromiss zwischen Dogmenglaube und Vernunftwissenschaft." (Die Autonomie des Denkens im 17. Jahrhundert, Gesammelte Schriften, II, 1929, p. 283). In spite of all the divergence caused by the Christian conception of divine revelation the attitude of that time, as far as I can judge, is best compared with that of the Greeks.

[30] Th. Gomperz, Griech. Denker[4], I, 1922, p. 257, says, "Mit ausserordentlicher Schärfe wird aber allem Supranaturalismus in zwei Erzeugnissen der Hippokratischen Schule (sc. the book on Water, Air and Places and the book on the Sacred Disease) der Krieg erklärt," although he admits that, according to the writers, "strenges Festhalten an ausnahmsloser Gesetzmässigkeit alles Naturgeschehens mit dem religiösen Glauben an einen göttlichen Urquell, aus dem im letzten Grunde eben dieses Naturgeschehen fliesse, vollkommen vereinbar sei." (p. 258). Concerning the book on the Sacred Disease and its attitude cf. pp. 212-13.

[31] W. H. Heidel, The Heroic Age of Science, 1933, p. 21. He recognizes that Greek science is not irreligious (p. 17) but the men of science maintain a common-

and special interference; he is not supposed to act arbitrarily. But what he loses on one side, he gains on the other: everything, being a natural event, is divine.

This theory of supernaturalism does not go uncontested even in the Hippocratic writings. The divine influence is still recognized, but it is understood to be only one factor just as is nature which is a power of its own. So the author of the book on the Sacred Disease says: "This disease is not in my opinion any more divine or more sacred than other diseases, but has its nature and origin." [83] And the same is repeated with the addition that the "origin of this disease, like that of other diseases, lies in heredity," that "the cause of this affection, as of the more serious illnesses generally, is the brain." [83] The conclusion is that "there is no need to put the disease in a special class and to consider it more divine than the others; they are all divine and all human. Each has a nature and power of its own." [84] What does this mean? It means that all diseases are divine

sense attitude toward life (p. 20); for the time being the gods seem to be virtually excluded from the world of nature; so far as they receive a place in it, they find it under the shadow of Law or Custom (p. 21). Heidel who stresses so much the importance of Greek medicine for the study of Greek science does not refer to the author of the book on Regimen as a physician, but only as an intellectual leader (p. 21); this invalidates his argument concerning medicine. Almost all the more important Hippocratic books recognize the gods as a real factor in nature. It is impossible here to deal with every one of them. I need only refer to the book on Flesh in which the power of thinking is ascribed to warmth. The author apparently agrees with Diogenes of Apollonia (cf. K. Deichgräber, Hippokrates über Entstehung u. Aufbau d. menschlichen Körpers, 1935, p. 2, 10-14). Diogenes did not only expound the theological aspect, he bitterly opposed, as he had to, the physiologists, those men who thought they could explain everything by nature devoid of the divine spirit. In attacking them he maintains that the power of God creates the world, as Plato says (cf. Sophistes 265c). This, by the way, proves that the expression *τῆς φύσιος τὴν ἀνάγκην* cannot be understood as purely mechanical (contrary to Heidel, Proceedings, l. c., p. 100, 81), but it is rather to be understood in the sense of the book on Regimen. It is interesting that from the 16th century on some interpreters of Hippocrates refer to the book on Flesh if they want to prove the religiosity of the great physician (cf. Deichgräber, l. c., pp. 56 sq.).

[83] Jones, l. c., II, p. 139 (slightly altered): *οὐδέν τί μοι δοκεῖ τῶν ἄλλων θειοτέρη εἶναι νούσων οὐδὲ ἱερωτέρη, ἀλλὰ φύσιν μὲν ἔχει καὶ πρόφασιν.*

[83] Jones, l. c., II, p. 151: *ἄρχεται δὲ ὥσπερ καὶ τἄλλα νοσήματα κατὰ γένος.* 153: *Ἀλλὰ γὰρ αἴτιος ὁ ἐγκέφαλος τούτου τοῦ πάθεος, ὥσπερ καὶ τῶν ἄλλων νοσημάτων τῶν μεγίστων.*

[84] Jones, l. c., II, 183: *ὥστε μηδὲν δεῖ ἀποκρίνοντα τὸ νόσημα θειότερον τῶν λοιπῶν νομίσαι, ἀλλὰ πάντα θεῖα καὶ πάντα ἀνθρώπινα. φύσιν δὲ ἕκαστον ἔχει καὶ δύναμιν ἐφ' ἑωυτοῦ.*

in so far as they are caused by sun and air and winds which are divine, as had been said before. They are human, apparently because they have their origin in heredity, in the organs of the body. It is impossible to admit the divinity of a special disease, for they are all divine; at the same time all diseases are human because of the influence of the body. The two spheres of the divine and of the natural are then fundamentally separate, although their influence is combined in every action.[85]

A similar theory has to be presupposed for the book on Prognostics. At the outset the physician is advised " to learn the natures of such diseases, how much they exceed the strength of men's bodies, besides whether there is any divine influence in them and to learn how to forecast them." [86] Divine influence and human nature again are separated as distinct forces. The nature of man is not in itself divine but the divine is thought to become apparent in the body. In what way this must be understood was already discussed in antiquity; the interpretations varied widely.[87] It seems to me that it is the

[85] Jones, l. c., I, p. x, without reference but, I think, mindful of these passages, says: "The 5th century B. C. witnessed the supreme effort of the Greeks to cast aside this incubus in all spheres of thought. They came to realize that to attribute an event to the action of a god leaves us just where we were, and that to call normal phenomena natural and abnormal divine is to introduce an unscientific dualism, in that what is divine (because mysterious) in one generation may be natural (because understood) in the next, while, on the other hand, however fully we may understand a phenomenon, there must always be a mysterious and unexplained element in it. All phenomena are equally divine and equally natural." This statement, I think, is not in accordance with the meaning of the Hippocratic author, as I tried to explain it. Everything is understood, even though it be in the form of a divine causality. On the other hand, the main theme of the book is not the uniformity of Nature, every aspect of which is equally divine (Jones, l. c., II, p. 135). It also follows from my interpretation that there is a difference in the basic theory between the book on the Sacred Disease and the book on Water, Air, and Places (contrary to Jones, l. c., II, pp. 130/1). Furthermore the thesis of Gomperz that the Hippocratic physicians rejected the belief in supernatural forces can certainly not be proved by the statement of this treatise; cf. p. 211, 30.

[86] Jones, l. c., II, pp. 6-8: *γνῶναι οὖν χρὴ τῶν τοιούτων νοσημάτων τὰς φύσιας, ὁκόσον ὑπὲρ τὴν δύναμίν εἰσιν τῶν σωμάτων ἅμα δὲ καὶ εἴ τι θεῖον ἔνεστιν ἐν τῇσι νούσοισι.* Following the edition of Kühlewein, Jones omits the words concerning the divine, but they are contained in all the manuscripts. Cf. also Hippocrates, ed. Littré, VII, 1851, p. 312.

[87] Galeni in Hippocratis Prognosticum, ed. I. Heeg, CMG, V, 9, 2, 1915, p. 205, 28 sq. Erotiani Vocum Hippocraticarum Collectio cum Fragmentis, rec. E. Nachmanson, 1918, p. 108, 10 sq.

spontaneous reactions which are signified by the word 'divine.' In one of the Hippocratic books it is stated: "In fact it is especially knowledge of the gods that by medicine is woven into the stuff of the mind . . . Physicians have given place to the gods. For in medicine that which is powerful is not in excess. In fact, though physicians take many things in hand, many diseases are also overcome for them spontaneously." [38] The physicians then make room for the gods in regard to the spontaneous reactions of the body which are considered as an interference of divine character, since they cannot be mastered by the human being. This is a theory unfamiliar neither to the 5th and 4th centuries B. C. nor to the later periods. Aristotle says: "There are a few to whom it seems that chance is a cause, but that it is not evident to human intelligence, since it is something divine and marvelous." [39] It is in this sense that the statement in this Hippocratic book and in the others can best be interpreted. The spontaneous reactions which are not the effects of human efforts and which can only be acknowledged as facts, are mentioned very often in the book on Prognostics as well as in the book on the Diseases of Women, the author of which states that the physician has first of all to consider the possible divine influence, then the nature of women, and many other things.[40] At any rate, many of the Hippocratic books, a greater number than identify God with nature, acknowledge the divine as a factor apart from nature which is a power of its own.

[38] Jones, l. c., II, p. 289: *Καὶ γὰρ μάλιστα ἡ περὶ θεῶν εἴδησις ἐν νόῳ αὐτῇ ἐμπλέκεται. οἱ δὲ ἰητροὶ θεοῖσι παρακεχωρήκασιν. οὐ γὰρ ἔνι περιττὸν ἐν αὐτῇ τὸ δυνασταῦον. καὶ γὰρ οὗτοι πολλὰ μὲν μεταχειρίονται, πολλὰ δὲ καὶ κεκράτηται αὐτοῖσι δι' ἀωυτῶν.*

[39] Aristotle, Physics, 196b, 5-7: *εἰσὶ δέ τινες οἷς δοκεῖ εἶναι αἰτία μὲν ἡ τύχη, ἄδηλοι δὲ ἀνθρωπίνῃ διανοίᾳ ὡς θεῖόν τι οὖσα καὶ δαιμονιώτερον.* Cf. Aristotle, The Physics, with an English Translation by P. H. Wicksteed and F. M. Cornford (Loeb Class. Library), Vol. I, 1929, pp. 146-7 where the parallels are quoted. Chance in the Aristotelian discussion is identical with spontaneity, cf. l. c., p. 120.

[40] E. Littré, Oeuvres complètes d'Hippocrate, VII, 1851, p. 312: *περὶ δὲ τῆῑ γυναικείῃ φύσιος καὶ νοσημάτων τάδε λέγω. μάλιστα μὲν τὸ θεῖον ἐν τοῖσι ἀνθρώποισι αἴτιον εἶναι. ἔπειτα αἱ φύσιες τῶν γυναικῶν καὶ χροιαί.* Heidel, The Heroic Age of Science, p. 18, characterizes this statement as the sort of curt remark that "one might perhaps expect to find in an unbelieving modern who wished to avoid offending sensibilities he respected but did not share." He points to the fact that later the divine does not occur, and this would be indeed an objection, as is already remarked by Galen (l. c., p. 208, 4-8). If one adopts the explanation I propose this objection is no longer valid, and the statement, obviously important, can be given its full value. Cf. also Hippocrates, ed. Littré, IX, 1861, p. 26; 28.

No doubt in some treatises God is even entirely excluded from the bodily processes. For in the 5th and 4th centuries B. C. there are many people who believe in the mechanism of the nature of plants, animals, and human beings: "Nature produces them out of a certain spontaneous cause and without any creative intelligence." [41] This, I think, is even the more common attitude at this time. For the deification of the individual organism is a modern and advanced idea in these centuries, one that is not yet generally accepted. Only a few individuals already visualize that "all things were arranged in the body, in a fashion conformable to itself, by fire, a copy of the whole, the small after the manner of the great and the great after the manner of the small." [42] And they are physicians. But others, just because they adore God, are aware of the contrast between Him and man, "the one being utterly corrupt, the other being perfectly holy." [43] They are physicians, too.

That the nature of everything is divine, that every process can only be understood as regulated by divine agency, is a conception which becomes current among men only in later times through Platonic, Aristotelian, and Stoic philosophy. It is, however, of the greatest importance that from the Hellenistic period on the religious rationalism is accepted by more and more scientists. For the mechanical and irreligious philosophy and science degenerated into avowed skepticism. The Epicureans do not care for a single and uniform explanation of the phenomena; they rejoice in manifold causes of the same event. The Empiricists refuse to explain anything because the human intellect cannot judge the causes and can discover only the proximate conditions. The Methodists deal only with the phenomena without considering causation at all. Scientific inquiry is restricted to dogmatic philosophers and scientists who alone feel able to determine the causes and are interested in the understanding of facts. Galen says in his book on the Use of the Parts that "this is a sacred book which I composed as a true hymn of the God who

[41] Plato, Sophistes 265c: *τὴν φύσιν αὐτὰ γεννᾶν ἀπό τινος αἰτίας αὐτομάτης καὶ ἄνευ διανοίας φυούσης.*

[42] Jones, l. c., IV, p. 247: *πάντα διεκοσμήσατο κατὰ τρόπον αὐτὸ ἑωυτῷ τὰ ἐν τῷ σώματι τὸ πῦρ, ἀπομίμησιν τοῦ ὅλου, μικρὰ πρὸς μεγάλα καὶ μεγάλα πρὸς μικρά.*

[43] Jones, l. c., II, p. 149: *οὐ μέντοι ἔγωγε ἀξιῶ ὑπὸ θεοῦ ἀνθρώπου σῶμα μιαίνεσθαι, τὸ ἐπικηρότατον ὑπὸ τοῦ ἀγνοτάτου.*

has created us, in the belief that I am really pious not if I sacrifice many hecatombs of oxen to Him and burn thousands of talents of cassia, but if I first recognize myself and then explain also to the others the wisdom of God, His power, His excellence." [44] This statement is significant. The fact that Platonic, dogmatic philosophy recognizes the power of God in nature does not mean the end of science, it is rather the stimulus to perfection of scientific knowledge and empirical understanding. If God did not exist, the world would be governed by chance alone but not by intelligible laws or recognizable causation. Moreover, nature separated from God would not be capable of inspiring in man enthusiasm for scientific investigation. Dogmatic philosophy alone leads the philosopher to an understanding of the phenomena and the physician to an explanation of diseases by sun and air or by the nature of the body.

These considerations in themselves suggest that a belief according to which diseases are caused by demons can not have had great bearing on Greek medicine. As a matter of fact there is, throughout antiquity, hardly one physician who accepts such a theory. The author of the book on the Sacred Disease, bitterly attacking those who trace epilepsy to the direct influence of a God or demon, does not give any indication that this opinion was held by physicians. He says that " those [men] who first attributed a sacred character to this malady were the same men who do it to-day, magicians, purifiers, charlatans and quacks." [45] A real physician apparently explained not even this disease by demons. The same thing is true of the 4th century A. D. when the physician Posidonius, very famous for his medical skill, is said to have denied that mania could be caused by a demon. There is no reason to suppose that this is a very unusual

[44] Galeni, De Usu partium, III, 10, ed. G. Helmreich, I, 1907, p. 174, 6-13: *ἱερὸν λόγον δ' ἐγὼ τοῦ δημιουργήσαντος ἡμᾶς ὕμνον ἀληθινὸν συντίθημι, καὶ νομίζω τοῦτ' εἶναι τὴν ὄντως εὐσέβειαν, οὐχὶ εἰ ταύρων ἑκατόμβας αὐτῷ παμπολλὰς καταθύσαιμι καὶ τάλαντα μυρία θυμιάσαιμι κασίας, ἀλλ' εἰ γνοίην μὲν αὐτὸς πρῶτος, ἔπειτα δὲ καὶ τοῖς ἄλλοις ἐξηγησαίμην οἷος μέν ἐστι τὴν σοφίαν, οἷος δὲ τὴν δύναμιν, ὁποῖος δὲ τὴν χρηστότητα.*

[45] Jones, l. c., II, p. 141 (slightly altered): *δοκέουσιν οἱ πρῶτοι τοῦτο τὸ νόσημα ἱερώσαντες τοιοῦτοι εἶναι ἄνθρωποι οἷοι καὶ νῦν εἰσι μάγοι τε καὶ καθάρται καὶ ἀγύρται καὶ ἀλαζόνες.* Cf. On the Diseases of Girls (*Περὶ παρθενίων*), Hippocrates ed. Littré, VIII, 1853, p. 468.

attitude; for the same opinion is expressed in Stephanus' Commentary to the Prognostics of Hippocrates.[46] And even in the 7th century A. D. physicians, it seems to me, no less than laymen, are convinced of the natural character of mental illnesses although at that time the demonological explanation is more and more emphasized.[47] And yet, concerning those affections the problem is at least thoroughly discussed in medical books, whereas in regard to the other diseases and their causation by the wrath of God or evil spirits, with the exception of a few places, the subject is not even mentioned in Greek medicine. Some commentators note that, in Hippocrates' Prognostic, the word divine might be understood as pestilence since "this affliction seems to be caused by God." [48] Galen, dealing with the same term, remarks that "a few believe illness could afflict men also through a certain wrath of the gods and that they try to prove this opinion quoting the authors of the so-called irrational stories." [49] Whether Galen is thinking of physicians or only of laymen, whether these people explain mental diseases alone in this way or other illnesses too, cannot be ascertained beyond a doubt. These are, how-

[46] On Posidonius cf. Philostorgius, Ecclesiastical History, VIII, 10 (GSS Philostorgius, p. 111, 12 sq. Bidez). Stephanus in Scholia in Hippocratem et Galenum, ed. F. R. Dietz, I, 1834, pp. 71 sq. Dölger (Antike u. Christentum IV, 1934, p. 106) assumes that the explanation of Posidonius is not a common one. He himself remarks that Origines attacks physicians who explain mental diseases in a natural way (l. c., p. 96).

[47] Sophronius Cyri et Joannis miracula, c. 54, Migne PG, 87, 3, 3624, says: *τοῦτον δοκίμοις ἰατροῖς ὑπεδείκνυον, ἀπὸ πλήθους μελαγχολικῶν χυμῶν τὰς συνεχεῖς ἐπιληψίας ἐκείνας καὶ μακρὰς καρηβαρείας συμβαίνειν οἰόμενοι· ἑκατέρας γὰρ ὡς ἔγνωμεν ἔπασχεν, τὰς μὲν συνεχέστερον, τὰς δὲ ἐντονώτερον καὶ μακρότερον: ἀλλ' ὡς μίαν πρὸς πάντων ἀπόφασιν ἤκουον ἀνθρώποις ἀνίκητον εἶναι τὸ νόσημα, πνεῦμα πονηρὸν καὶ οὐ μελαγχολικὸν χυμὸν ἔχων τὸ νόσημα.* Certainly the physicians do not know in this case how to cure the disease; this however they sometimes do not know in the 5th century B. C. either. Apparently the Christian book wants to use the authority of the physicians as proof for the healing-power of the Saints and does not describe the actual situation correctly. Otherwise it would be hard to reconcile that the laymen originally believed in the natural character of epilepsy, yet, that the physicians are said not to have been of the same opinion.

[48] Erotian, ed. Nachmanson, l. c., p. 108, 18-19: *διὰ τὸ τοὺς λοιμοὺς ἐκ θεοῦ δοκεῖν εἶναι.*

[49] Galen, In Hippocratis' Prognostic, l. c., p. 206, 3-5: *ἔνιοι μὲν γὰρ οἴονται καὶ διὰ θεῶν τινα ὀργὴν γίνεσθαι τοῖς ἀνθρώποις νοσήματα καὶ λέγουσί γε μαρτυρίαν τῆς δόξης ταύτης παρὰ τῶν γραψάντων τὰς καλουμένας ἱστορίας ἄνευ λόγου.* Cf. also Celsus, CML, I, 1915, p. 17, 15-16: Eodem vero auctore [sc. Homero] disci potest morbos tum (!) ad iram deorum immortalium relatos esse.

ever, the only instances to be found in the works of Hippocrates and Galen and of the other medical writers. One is justified, then, in saying not only that the Greek physicians rejected the explanation by demonology but also that they did not take it seriously, that they treated the subject as negligible.

This attitude of the physicians is not an isolated one. The ancient philosophers also unanimously disagreed with the belief that diseases could be caused by demons. Not in Platonic or Aristotelian or Stoic philosophy, still less, of course, in the Scepsis are the demons held responsible for illness. Again the problem is scarcely mentioned; it seems unnecessary to deal with it very thoroughly.[50] Also the Neo-Platonists disregard such a theory. Plotinus says: "They tell us they can free themselves of diseases. If they meant, by temperate living and an appropriate regime, they would be right and in accordance with all sound knowledge. But they assert diseases to be Spirit-Beings and boast of being able to expell them by formulae: this pretention may enhance their importance with the crowd, gaping upon the powers of magicians; but they can never persuade the intelligent that disease arises otherwise than from such causes as overstrain, excess, deficiency, putrid decay, in a word some variation whether from within or from without. The nature of illness is indicated by its very cure. A motion, a medicine, the letting of blood, and the disease shifts down and away; sometimes scantiness of nourishment restores the system: presumably the Spiritual power gets hungry or is debilitated by the purge. Either this Spirit makes a hasty exit or it remains within. If it stays, how does the disease disappear, with the cause still present? If it quits the place, what has driven it out? Has anything happened to it? Are we to suppose it throve on the disease? In that case the disease existed as something distinct from the Spirit-Power. Then again, if it steps in where no cause of sickness exists, why should there be anything else

[50] One usually refers to Plato's Phaedrus, 244d, in order to prove that Plato, at least, explained diseases by the interference of God. But he is only speaking of mania, one of the gravest diseases and burdens, which, in this myth, he traces back to a kind of divine possession like the gift of prophecy and poetry. For Plato's theory on diseases, even on mental diseases, cf. Timaeus, 81e-86b. For the Stoics' cf. Diogenes Laertius, VII, 158. The Neo-Pythagoreans are the only philosophical sect of late antiquity which recognizes at least purifications (cf. Diogenes Laertius, VIII, 33).

but illness? If there must be such a cause, the Spirit is unnecessary: that cause is sufficient to produce that fever. As for the notion, that just when the cause presents itself, the watchful Spirit leaps to incorporate itself with it, this is simply amusing." [51] This statement proves that even the latest philosophical system of antiquity, the one which is generally held responsible for so much superstition of the ancients, rejected the demonological explanation of diseases categorically. At the same time the polemic of Plotinus shows that the Gnostic philosophy did accept such a doctrine of causation, a philosophy which combined Greek ideas with Christian religion. It is the Christians and the Jews who propagated these ideas at the end of Greek and Roman history as the Persians and Chaldeans had done in the very beginning.[52]

[51] Plotinus, Psychic and Physical Treatises; Comprising the Second and Third Enneades, Translated from the Greek by S. Mackenna, London 1921, Vol. II, p. 235. (Plotin., Enneades II, 9, 14): *καθαίρεσθαι δὲ νόσων λέγοντες αὐτοὺς λέγοντες μὲν ἂν σωφροσύνῃ καὶ κοσμίᾳ διαίτῃ ἔλεγον ἂν ὀρθῶς, καθάπερ οἱ φιλόσοφοι λέγουσι. νῦν δὲ ὑποστησάμενοι τὰς νόσους δαιμόνια εἶναι καὶ ταῦτα ἐξαιρεῖν λόγῳ φάσκοντες δύνασθαι καὶ ἐπαγγελλόμενοι σεμνότεροι μὲν ἂν εἶναι δόξαιεν παρὰ τοῖς πολλοῖς, οἳ τὰς παρὰ τοῖς μάγοις δυνάμεις θαυμάζουσι τοὺς μέντοι εὖ φρονοῦντας οὐκ ἂν πείθοιεν, ὡς οὐχ αἱ νόσοι τὰς αἰτίας ἔχουσιν ἢ καμάτοις ἢ πλησμοναῖς ἢ ἐνδείαις ἢ σήψεσι καὶ ὅλως μεταβολαῖς ἢ ἔξωθεν τὴν ἀρχὴν ἢ ἔνδοθεν λαβούσαις. δηλοῦσι δὲ καὶ αἱ θεραπεῖαι αὐτῶν. γαστρὸς γὰρ ῥυείσης ἢ φαρμάκου δοθέντος διεχώρησε κάτω εἰς τὸ ἔξω τὸ νόσημα καὶ αἵματος ἀφῃρημένου, καὶ ἔνδεια δὲ ἰάσατο, ἢ πεινήσαντος τήκεσθαι, ποτὲ δὲ ἀθρόως ἐξελθόντος, ἢ μένοντος ἔνδον. ἀλλ' εἰ μὲν ἔτι μένοντος, πῶς ἔνδον ὄντος οὐ νοσεῖ ἔτι; εἰ δὲ ἐξελήλυθε, διὰ τί; τί γὰρ αὐτὸ πέπονθεν; ἢ ὅτι ἐτρέφετο ὑπὸ τῆς νόσου: ἦν ἄρα ἡ νόσος ἑτέρα οὖσα τοῦ δαίμονος. ἔπειτα, εἰ οὐδενὸς ὄντος αἰτίου εἴσεισι, διὰ τί οὐκ ἀεὶ νοσεῖ; εἰ δὲ γενομένου αἰτίου, τί δεῖ τοῦ δαίμονος πρὸς τὸ νοσεῖν; τὸ γὰρ αἴτιον τὸν πυρετὸν αὐταρκές ἐστιν ἐργάσασθαι. γελοῖον δὲ τὸ ἅμα τὸ αἴτιον γενέσθαι καὶ εὐθέως ὥσπερ παρυποστῆναι τῷ αἰτίῳ τὸ δαιμόνιον ἕτοιμον ὄν.*

[52] Concerning the early Christian attitude toward diseases, cf. A. Harnack, Medizinisches aus der ältesten Kirchengeschichte, 1892, pp. 71 sq. The Jewish belief is most clearly formulated by Josephus, Antiquitates, VIII, 2, 5. Already Pliny traces the origin of magic back to Persians and Chaldeans on the one hand, to the Jews on the other. (Natural History, introduction to book XXX). The modern attempt to find magic in all centuries of Greek history is not convincing. Hopfner, (Realenzyklopädie d. klass. Altertumswiss., XIV, 1, pp. 301 sq., s. v. Mageia) collects the whole material; his survey only serves to prove that before the 3rd century B. C. magic is not an important factor in Greek life. I do not presume to decide whether the situation was always different from that which is to be found in other countries and in primitive men, as Ed. Meyer assumes (Gesch. d. Altertums, I, $1^{2}$, pp. 93 sq.). So much is certain, that in Greece magic is revived only under foreign influences in later times (cf. Ed. Meyer, l. c., p. 98). Cf. Lucian's Tragodopodagra, v. 265 sq. *Σύροι μέν ἐσμεν, ἐκ Δαμασκοῦ τῷ γένει.*

It is certain that philosophers and physicians do not believe demons to be the cause of disease. Not only is the scientific theory hostile to such an opinion,—this would explain only the attitude of the trained physicians, of the followers of the various medical schools—even the average educated man did not believe in the demonic character of diseases; his behavior as a patient was conditioned by this attitude. Modern interpretation is inclined more and more to claim that Greeks and Romans, in general, traced back the origin of diseases to possession by demons.[53] If this were correct, a queer contradiction of the data would arise. For these men are supposed to be the patients of physicians who apparently do not believe in demons, who do not even try to prove that in a special case it is the body and not a demon which has brought about the illness. Or did people call in only those unknown practitioners who did themselves believe in demons? But no physician could afford to do this. If the illness was caused by a demon, nothing could be done by the doctor. He must retire and give way to the magician. In such a case " he is expelled from the house " and the patient will say: " Oh, sir, leave me to pay my penalty, impious wretch that I am, accursed and hateful to the gods and all the heavenly host." [54] After all, the physicians had patients; people must have thought them able to do something. The natural explanation of diseases must have been generally accepted.

The reasons for this acceptance can be ascertained by inquiring into the causes for the rejection of a demonological interpretation of disease. It is the author of the book on the Sacred Disease who says of the assumptions of the magicians that they " show, not piety, as they think, but impiety rather, implying that the gods do not exist, and what they call piety and the divine is, as I shall prove, impious

[53] The modern interpretation is to be found in the article on Demons, RE, Supplement III, p. 267 sq.; p. 272, 38; cf. also Halliday, l.c., p. 281; E. Stemplinger, Sympathieglaube u. Sympathiekuren in Altertum u. Neuzeit, 1919, p. 5: " So ist das ganze Griechisch-Römische Altertum trotz Hippokrates erfüllt von dem Glauben an den Krankheitsdämon." The argument in these books is usually based on passages taken from poetry which cannot be acknowledged as the only and adequate instance in this problem. Moreover, it is again the mental diseases to which those passages mostly refer, and here the problem is a peculiar one, cf. pp. 216-17.

[54] Plutarch, On Superstition (Plutarch's Moralia, with an English Translation by F. C. Babbitt, Loeb Class. Library, II, 1928, p. 475): *ἔα με, ἄνθρωπε, διδόναι δίκην, τὸν ἀσεβῆ, τόν ἐπάρατον, τόν θεοῖς καὶ δαίμοσι μεμισημένον.* Cf. also Lucian, Philopseudes, 36.

and unholy." [55] The physicians then not only believe that they can explain diseases in another and more scientific way. They rely also on religious argumentation. For they hold "that a man's body is not defiled by God, the one being utterly corrupt, the other perfectly holy." [56] In slightly different terms Posidonius says the same thing in the 4th century A. D.: "men do not become ill through the affliction of demons . . . for it is not at all in the power of the demons to afflict the nature of men." [57] A god cannot pollute or possess the human body. The physicians apparently subscribe to the Platonic saying: "It is good since it comes into being by divine destiny." [58] In this way they adopt the Olympian religion and reject the chthonic cults; they adopt the pious reverence of the gods and reject purifications.

From the aspect of such a belief in antiquity, too, all magical rites are superstitious, as is revealed by Plutarch's discussion of superstition: "In the estimation of the superstitious man, [all the indispositions] of his body . . . are classed as afflictions of God or attacks of an evil spirit. For this reason he has no heart to relieve the situation or undo its effects, or to find some remedy for it, or to take a strong stand against it lest he seem to fight against God and to rebel at his punishment." [59] Superstitious as this man is, he will use only rites and purifications, in contrast to the atheist who "when he is ill, takes into account and calls to mind the times when he has eaten too much or drunk too much wine, also irregularities in his daily life, or instances of over-fatigue or unaccustomed changes of air or locality." [60]

[55] Jones, l. c., II, p. 145: *καίτοι ἔμοιγε οὐ περὶ εὐσεβείης τοὺς λόγους δοκέουσι ποιεῖσθαι, ὡς οἴονται, ἀλλὰ περὶ ἀσεβείης μᾶλλον, καὶ ὡς οἱ θεοὶ οὐκ εἰσί, τὸ δὲ εὐσεβὲς αὐτῶν καὶ τὸ θεῖον ἀσεβές ἐστι καὶ ἀνόσιον, ὡς ἐγὼ διδάξω.*

[56] Jones, l. c., II, p. 149, cf. p. 215, 43.

[57] Philostorgius, l. c.: *θεάσασθαι δὲ τὸν Ποσειδώνιον ἐν ἰατρικῇ διατρέποντα. λέγειν δ' αὐτὸν ὅμως οὐκ ὀρθῶς οὐχὶ δαιμόνων ἐπιθέσει τοὺς ἀνθρώπους ἐκβακχεύεσθαι, ὑγρῶν δέ τινῶν κακοχυμίαν τὸ πάθος ἐργάζεσθαι· μηδὲ γὰρ εἶναι τὸ παράπαν ἰσχὺν δαιμόνων ἀνθρώπων φύσιν ἐτηρεάζουσαν.*

[58] Plato, Phaedrus 244 c.: *ὡς καλοῦ ὄντος, ὅταν θείᾳ μοίρᾳ γίγνηται.*

[59] Plutarch, On superstition, l. c., II, p. 475: *τῷ δὲ δεισιδαίμονι καὶ σώματος ἀρρωστία πᾶσα καὶ . . . πληγαὶ θεοῦ καὶ προσβολαὶ δαίμονος λέγονται. ὅθεν οὐδὲ τολμᾷ βοηθεῖν οὐδὲ διαλύειν τὸ συμβεβηκὸς οὐδὲ θεραπεύειν οὐδ' ἀντιτάττεσθαι, μὴ δόξῃ θεομαχεῖν καὶ ἀντιτείνειν κολαζόμενος.*

[60] Plutarch, On superstition, l. c., II, p. 473: *Νοσῶν θ' ὁ ἄθεος ἐκλογίζεται καὶ ἀναμιμνήσκεται πλησμονὰς αὐτοῦ καὶ οἰνώσεις καὶ ἀταξίας περὶ δίαιταν ἢ κόπους ὑπερ-*

For the Romans, too, the use of purification—the explanation of diseases by demons or gods—is superstition. It is Pliny who says: "To believe that there are a number of gods derived from the virtues and vices of man . . . indicates still greater folly. Human nature, weak and frail as it is, mindful of its own infirmity, has made these divisions, so that every one might have recourse to that which he supposed himself to stand more particularly in need of. Hence we find different names employed by different nations; the inferior deities are arranged in classes, and diseases and plagues are deified, in consequence of our anxious wish to propitiate them. It was from this cause that a temple was dedicated to Fever, at the public expense, on the Palatine Hill." [61] The Roman poet knows that "the mysteries of cruel magicians are abominated by the heavenly gods." [62] It is admitted that "our forefathers believed that purifications could remove the cause of every evil," [63] the implication being that later, in the Roman Empire, at least the educated classes and all men who worship the Olympians reject such a belief. It is emphasized, however, that "it was in Greece that the custom originated." In the same way Plutarch claims an alien origin for magic which, he says, the Greeks took over "from the barbarians, learning their evil knowledge." [64] Certainly, the demonic conceptions are influential in Rome as well as in Greece, but they are consciously suppressed. Both nations assert the foreign character of those beliefs, as usual making another people responsible for them; even if purifications are used,

*βάλλονται ἢ μεταβολὰς ἀέρων ἀήθεις καὶ τόπων.* Plutarch in this passage is speaking of the atheist because he intends to contrast his behavior with that of the superstitious. But he presupposes the same attitude for the pious man.

[61] The Natural History of Pliny, II, 15, Translated by J. Bostock and H. T. Riley, I, 1893, p. 21 (cf. Cicero, De Natura deorum, III, 63 and De legibus, II, 28): In numeros quidem credere atque etiam ex vitiis hominum . . . majorem ad socordiam accedit. Fragilis et laboriosa mortalitas in partes ista digessit infirmitatis suae memor, ut portionibus coleret quisque quo maxime indigeret. Itaque nomina alia aliis gentibus et numina in iisdem innumerabilia invenimus, *inferis* quoque in genera discriptis, morbisque et multis etiam pestibus, dum esse placatas trepido metu cupimus. Ideoque etiam publice Febris fanum in Palatio dicatum est.

[62] Lucan, The Civil War VI, 430-31: superis detestanda deis saevorum arcana magorum.

[63] Ovid, Fasti II, 35-37: Omne nefas omne mali purgamina causam credebant nostri tollere posse senes.

[64] Ovid, l. c., 38: Graecia principium moris fuit. Plutarch, On Superstition, 166: *ὦ βάρβαρ' ἐξευρόντες Ἕλληνες κακά.*

they do not belong to that ritual which is recognized as the old and genuine religion.[65] To be sure, one is not justified in holding as the most characteristic feature of their behavior feelings which are held in contempt by men themselves. What is thought to be superstitious by the ancients, cannot be interpreted as their general attitude toward disease.[66]

It stands to reason then that the Greek physicians understood illness as caused by sun and air and winds or by the nature of man, and that the average people accepted this explanation. Physicians and laymen, however, usually considered these factors as the expression of divine agencies; the merely natural interpretation was as rare and restricted as the superstitious belief in demons; both are exceptional cases, departures from the rule. It is not by chance that Asclepius is the god of doctors and of patients. He represents the rational theology in the Greek sense, in sharp opposition to every demonic religion, to magical rites and purifications, as the inscription on his temple in Epidaurus reveals: " Pure must be he who enters the fragrant temple; purity means to think nothing but holy thought." [67]

[65] Cf. J. Bernays, Theophrastos' Schrift über Frömmigkeit, Berlin 1866, p. 106. He stresses the fact that sacrifices for the sake of purifications, the latest in the development of Greek religion, are not on the same plane as the other sacrifices, even in the time of Theophrastos, who classifies the Orphic mysteries also among superstitious rites (in his characterization of the superstitious). Concerning earlier centuries and their dislike of purifications, cf. e. g., Plato, Republic, 364b, in regard to a later period cf. the Neo-Platonic polemic in the book of Porphyry, described by Bernays, l. c.

[66] The contention of the pious man that it is God who sends the disease, expressed already in the Homeric Epic (Cf. Odyssee, V, 394-97; IX, 409-11, also the pestilence in the first book of the Iliad is sent from God) must have been common to every period. But even in the epic no purifications are used, those which are mentioned concern only the usual preparation for prayers and sacrifices. (Iliad, I, 313, contrary to E. Rohde, Psyche[9-10], II, 1921, p. 76, 1, who himself is more cautious in his judgment p. 71.) At any rate, the pious belief must be carefully differentiated from the theory that disease is a kind of pollution which has to be purified. These are two different attitudes. Already Hesiod says (Erga 102-4): *νοῦσοι δὲ ἀνθρώποισιν ἐφ' ἡμέρῃ αἱ δ' ἐπὶ νυκτὶ αὐτόματοι φοιτῶσι κακὰ θνητοῖσι φέρουσαι σιγῇ, ἐπεὶ φωνὴν ἐξείλετο μητίετα Ζεύς.*

[67] Porphyry, De abstinentia Animae, II, 19: *ἁγνὸν χρὴ ναοῖο θυώδεος ἐντὸς ἰόντα / ἔμμεναι. ἁγνεία δ' ἐστι φρονεῖν ὅσια.* I shall not discuss whether Asclepius was originally a chthonic Hero or not. There is no doubt that he came to be generally accepted by the ancient world as an Olympian.

## II

### The Treatment of Diseases

The myth of the god Asclepius says that of "those whosoever came suffering from the sores of nature, or with their limbs wounded, either by grey bronze or by far-hurled stone, or with bodies wasting away with summer's heat or winter's cold, he loosed and delivered divers of them from diverse pains, tending some of them with kindly songs, giving to others a soothing potion, or, haply, swathing their limbs with simples, or restoring others by the knife." [67] The god, in his treatment of diseases resorts to music, to drugs applied either internally or externally and to the use of the knife. The human physician is a surgeon and a pharmacologist, he invents the regulation of diet, in rare cases he has recourse to music. The therapy of Greek as well as of Roman physicians is, then, throughout the centuries a scientific and natural one. But again it is necessary to determine the principles underlying the scientific and natural method of healing.

It is the aim of surgery and dietetics to influence the disease by the action and understanding of the physician. So far no other than human power is involved, yet, there is the problem to what extent the body can be helped at all from the outside, how much the healing-process as such depends not on what is done by the physician but on what is achieved by the bodily forces themselves. In other words, what value can be attributed to the medical art? The various physicians answer this question in different ways, depending on their different metaphysical standpoints. Plato remarks that all those who understand nature as a power of its own devoid of god, at the same time deprive the different arts of their efficacy. Like heaven and the stars and the seasons, they say, animals and plants have been produced by the elements. "Not through reason nor through any god

[67] Pindar, Pythian Odes, III, 47-53 (The Odes of Pindar with an English translation by Sir John Sandys, Loeb Class. Library, 1927, p. 189): *τοὺς μὲν ὧν, ὅσοι μόλον αὐτοφύτων ἑλκέων ξυνάορες, ἢ πολιῷ χαλκῷ μέλη τετρωμένοι ἢ χερμάδι τηλεβόλῳ, ἢ θερινῷ πυρὶ περθόμενοι δέμας ἢ χειμῶνι, λύσαις ἄλλον ἀλλοίων ἀχέων ἔξαγεν, τοὺς μὲν μαλακαῖς ἐπαοιδαῖς ἀμφέπων, τοὺς δὲ προσαρέα πίνοντας, ἢ γυίοις περάπτων πάντοθεν φάρμακα τοὺς δὲ τομαῖς ἔστασεν ὀρθούς.* The translation of *μαλακαῖς ἐπαοιδαῖς* differs from the usual one, for the explanation thereof cf. p. 235, 102.

or art, but . . . through nature and chance. Art, however, later arising therefrom, comes into being later and is itself mortal since it is born from mortal things. Later on it creates some playthings which do not much partake of truth. . . . Arts which create something serious also are those which join their power with nature—like medicine, agriculture, and gymnastics." [69] Medicine according to such an atheistic theory undoubtedly belongs to those arts which accomplish something real, but medical art considered in this light, is no longer a factor of its own. The result of its action derives from a source outside the art; the artist becomes simply the helpmate of nature. This is the theory expressed also by one of the Epidemiae: "Nature is the physician of diseases." [70] Thus, the power of nature is raised to its highest level, but in that case the physician must abdicate. If nature heals diseases then the physician ceases to do so. Such a theory is destructive of medical art.

No one will deny that "if nature be in opposition, everything is vain." [71] For "if a man demand from an art a power over what does not belong to the art, or for nature a power over what does not belong to nature, his ignorance is more alike to madness than to lack of knowledge." [72] These exaggerations aside, however, the reality of the art as a force which need not be derived from another force cannot be doubted. Neither chance nor spontaneous healing can contradict the proper value of medicine. Moreover, "if the medical art and medical men brought about a cure only by means of medicines, purgative or astringent, my argument would be weak. As it is, the physicians of greatest repute obviously cure by regimen and by other

[69] Plato, Laws, X, 889c-d: *οὐδὲ διά τινα θεὸν οὐδὲ διὰ τέχνην ἀλλὰ . . . φύσει καὶ τύχῃ. τέχνην δὲ ὕστερον ἐκ τούτων ὑστέραν γενομένην, αὐτὴν θνητὴν ἐκ θνητῶν ὕστερα γεγεννηκέναι παιδιάς τινας, ἀληθείας οὐ σφόδρα μετεχούσας . . . αἳ δέ τι καὶ σπουδαῖον ἅρα γεννῶσι τῶν τεχνῶν, εἶναι ταύτας ὁπόσαι τῇ φύσει ἐκοίνωσαν τὴν αὐτῶν δύναμιν, οἷον αὖ ἰατρικὴ καὶ γεωργικὴ καὶ γυμναστική.*

[70] Hippocrates, ed. Littré, V, p. 314, *νούσων φύσιες ἰητροί.* The author expressly says that to him nature is devoid of thinking and accomplishes everything without having learned it. This corresponds to the Platonic characterization of natural and irreligious philosophy and shows that the statement of the Hippocratic book can be linked with this theory. (Contrary to Deichgräber's reading S B Berl. 1933, 3, 52.)

[71] Jones, l. c., II, p. 263: *φύσιος γὰρ ἀντιπρησσούσης κενεὰ πάντα.* Although these words are used in regard to education, they are certainly valid in a wider sense too.

[72] Jones. l. c., II, p. 203: *εἰ γάρ τις ἢ τέχνην ἐς ἃ μὴ τέχνη, ἢ φύσιν ἐς ἃ μὴ φύσις πέφυκεν, ἀξιώσειε δύνασθαι, ἀγνοεῖ ἄγνοιαν ἁρμόζουσαν μανίῃ μᾶλλον ἢ ἀμαθίῃ.*

substances, which nobody—not only a physician but also an unlearned layman, if he heard of them—would say do not belong to the art. Seeing then that there is nothing that cannot be put to use by good physicians and by the art of medicine itself, but in most things that grow or are made are present the essential substances of cures and of drugs, no patient who recovers without a physician can logically attribute the recovery to spontaneity. Indeed, under a close examination spontaneity disappears; for everything that occurs will be found to do so through something, and this 'through something' shows that spontaneity is a mere name, and has no reality. Medicine, however, because it acts 'through something,' and because its results may be forecasted, has reality, as is manifest now and will be manifest for ever." [73] In this way the self-sufficiency of medical art is demonstrated on a rational basis contrary to the naturalists and disbelievers.

It is the usual attitude for the physician which is formulated in the first book of the Epidemiae: "The art has three factors, the disease, the patient, the physician. The physician is the servant of the art. The patient must cooperate with the physician in combating the disease." [74] Art and nature are thus properly evaluated. In the fight against illness, the knowledge of the physician is one factor, nature the other. Yet such a conception obviously presupposes a belief which gives God his share in the processes of the world. It is again the religious rationalist who, contrary to the atheistic thinker, has real confidence in his art. He notes equally and fairly the success and failure of nature. For nature, to him, has two different aspects:

[73] Jones, l. c., II, pp. 199-201: *Ἔτι τοίνυν εἰ μὲν ὑπὸ φαρμάκων τῶν τε καθαιρόντων καὶ τῶν ἱστάντων ἡ ἴησις τῇ τε ἰητρικῇ καὶ τοῖσιν ἰητροῖσι μοῦνον ἐγίνετο, ἀσθενὴς ἦν ἂν ὁ ἐμὸς λόγος. νῦν δὲ φαίνονται τῶν ἰητρῶν οἱ μάλιστα ἐπαινεόμενοι καὶ διαιτήμασιν ἰώμενοι καὶ ἄλλοισί γε εἴδεσιν, ἃ οὐκ ἄν τις φαίη, μὴ ὅτι ἰητρός. ἀλλ' οὐδὲ ἰδιώτης ἀνεπιστήμων ἀκούσας, μὴ οὐ τῆς τέχνης εἶναι. ὅπου οὖν οὐδὲν οὔτ' ἐν τοῖς ἀγαθοῖσι τῶν ἰητρῶν οὔτ' ἐν τῇ ἰητρικῇ αὐτῇ ἀχρεῖόν ἐστιν, ἀλλ' ἐν τοῖσι πλείστοισι τῶν τε φυομένων καὶ τῶν ποιευμένων ἔνεστι τὰ εἴδεα τῶν θεραπειῶν καὶ τῶν φαρμάκων, οὐκ ἔστιν ἔτι οὐδενὶ τῶν ἄνευ ἰητροῦ ὑγιαζομένων τὸ αὐτόματον οὐδὲν φαίνεται ἐὸν ἐλεγχόμενον. πᾶν γὰρ τὸ γινόμενον διά τι εὑρίσκοιτ' ἂν γινόμενον, καὶ ἐν τῷ διά τι τὸ αὐτόματον οὐ φαίνεται οὐσίην ἔχον οὐδεμίην ἀλλ' ἢ ὄνομα. ἡ δὲ ἰητρικὴ καὶ ἐν τοῖσι διά τι καὶ ἐν τοῖσι προνοουμένοισι φαίνεταί τε καὶ φανεῖται αἰεὶ οὐσίην ἔχουσα.*

[74] Jones, l. c., I, p. 165: *ἡ τέχνη διὰ τριῶν, τὸ νόσημα καὶ ὁ νοσέων καὶ ὁ ἰητρός. ὁ ἰητρὸς ὑπηρέτης τῆς τέχνης· ὑπεναντιοῦσθαι τῷ νοσήματι τὸν νοσέοντα μετὰ τοῦ ἰητροῦ.*

it not only heals, it also destroys. The physician, in some cases, can rely on it, in others he must fight against it.[75]

All these ideas, I think, are summed up in the statement "that there could surely be nothing more useful or more necessary to know than these things (sc. which the physician knows) and how the first discoverers, pursuing their inquiries excellently and with suitable application of reason to the nature of man, made their discoveries, and thought their art worthy to be ascribed to a god, as in fact is the usual belief.[76] For medicine is so great a power and is so mighty in itself that a god must have given it to mankind. The rational element contained in medical art is divine. Yet very seldom does this conviction lead to an exaggeration of the power of the art. In contrast to the conception that nature alone, not the physician, heals the disease, it is stated in one book: "By stitching and cutting, that which is rotten in men is healed by physicians. This too is part of the physician's art: to do away with that which causes pain, and by taking away the cause of his suffering to make him sound. Nature of herself knows how to do these things. When a man is sitting it is a labour to rise; when he is moving it is a labour to come to rest. In other respects too nature has the same qualities as has medical art."[77] The religious physician is usually aware of the limits of his art as his definition of medicine reveals: 'In general terms, it is to do away with the sufferings of the sick, to lessen the violence of their diseases, and to refuse to treat those who are over-

[75] M. Neuburger, Die Heilkraft d. Natur, 1926, pp. 9-10, stresses the fact that in the Hippocratic books the healing power of nature is not exaggerated in a phantastic measure. He is also of the opinion that thereby the negativism and quietism is avoided which very easily results from too strong a belief in nature.

[76] Jones, l. c., I, 37: *οὐκ ἂν οὖν ἕτερα τούτων χρησιμώτερα οὐδὲ ἀναγκαιότερα εἴη εἰδέναι δήπου, ὡς δὲ καλῶς καὶ λογισμῷ προσήκοντι ζητήσαντες πρὸς τὴν τοῦ ἀνθρώπου φύσιν εὗρον αὐτὰ οἱ πρῶτοι εὑρόντες καὶ ᾠήθησαν ἀξίην τὴν τέχνην θεῷ προσθεῖναι, ὥσπερ καὶ νομίζεται.*

[77] Jones, l. c., IV, pp. 253-55 (slightly altered): *κεντεόμενοί τε καὶ τεμνόμενοι τὰ σαθρὰ ὑπὸ τῶν ἰητρῶν ὑγιάζονται. καὶ τόδε ἰητρικῆς. τὸ λυπέον ἀπαλλάσσειν, καὶ ὑφ' οὗ πονεῖ ἀφαιρέοντα ὑγιέα ποιεῖν. ἡ φύσις αὐτομάτη ταῦτα ἐπίσταται. καθήμενος πονεῖ ἀναστῆναι, κινεόμενος πονεῖ ἀναπαύσασθαι, καὶ ἄλλα τὰ αὐτὰ ἔχει ἡ φύσις ἰητρικῇ.* It is in accordance with the interpretation given in regard to the attitude of the physician that the book on Ancient Medicine states that the nature of man consisting of the mixture of the humors can and should be voluntarily altered by the physician. The same is valid for the book on the Nature of Man (Jones, l. c., IV, p. 10) and,

mastered by their diseases, realizing that in such cases medicine is powerless." [78]

In later centuries the recognition of nature as a teleological power must have confirmed the advisability of the withdrawal of the physicians. Themison, who does not believe in teleology, is the first to proceed farther than the physicians before him and to write methodically about the treatment of chronic diseases. Erasistratos, admitting that nature does many things in vain, and Asclepiades, stating that nature cannot heal at all, are the only physicians whose treatment of some of the chronic diseases is especially mentioned.[79] This development is reflected by the change in the attitude of the doctor. For in the Hippocratic book it is said: "I should most commend a physician who in acute diseases, which kill the great majority of patients, shows some superiority." [80] In the books of the Methodists it is the chronic diseases "which bring those who have experience in medicine great and eternal fame." [81] In this case the merely natural and mechanistic understanding of nature brought about a progress in medicine; but this is an exception; in general, like in the explanation of phenomena, the Dogmatists are more progressive than the Methodists.

I think, for more of the Hippocratic writings. But it is impossible again to deal with all of them in this connection.

[78] Jones, l. c., II, p. 193: *τὸ δὴ πάμπαν ἀπαλλάσσειν τῶν νοσεόντων τοὺς καμάτους καὶ τῶν νοσημάτων τὰς σφοδρότητας ἀμβλύνειν, καὶ τὸ μὴ ἐγχειρεῖν τοῖσι κεκρατημένοις ὑπὸ τῶν νοσημάτων, εἰδόταs ὅτι ταῦτα οὐ δύναται ἰητρική.* As regards the restraint of Hippocratic physicians and the modern discussion of this problem cf. Jones, l. c., I, p. XVI sq.

[79] Caelius Aurelianus, De morbis acutis et chronicis, ed. I. C. Amman, 1709, pp. 267-68: scribentium igitur medicinam nullus ante Themisonem tardarum passionum curationes principaliter ordinavit . . . Alii disperse atque de aliis passionibus scribentes . . . ut Erasistratus et Asclepiades. Themison autem tardarum passionum tres libros scripsit. As regards the attitude of Erasistratus and Asclepiades toward nature cf. Neuburger, l. c., p. 11 sq., who is not aware of the connection between these divergent theories and the discovery of the treatment of chronic diseases.

[80] Jones, l. c., II, p. 67: *μάλιστα δ' ἂν ἐπαινέσαιμι ἰητρόν, ὅστις ἐν τοῖσιν ὀξέσι νοσήμασι, ἃ τοὺς πλείστους τῶν ἀνθρώπων κτείνει ἐν τούτοισι διαφέρων τι τῶν ἄλλων εἴη ἐπὶ τὸ βέλτιον.* Cf. also the beginning of the Prognostic of Hippocrates.

[81] Caelius Aurelianus, l. c., peritis medicinae claram eternamque gloriam quaerunt. Cf. Aretaeus, ed. C. Hude, CMG, II, 1923, pp. 36, 4 sq.; p. 144, 3 sq.

These considerations are of course important not only for surgery and dietetics, but also for pharmacology. In the treatment by drugs, too, the question arises how far the physician is able to help or must rely on the nature of the patient. On the other hand, there is a specific problem of pharmacology in connection with the efficacy of plants. Certainly herbs are prescribed as a means of natural therapy. If one remembers the ambiguity of the term "nature" in ancient medicine, one immediately realizes that in the administration of remedies also various attitudes must be differentiated from one another. All those men to whom nature is devoid of God also see in plants nothing but natural powers. But it is not only the superstitious layman, Pliny, who recognizes the grandeur and power of God, especially in the vegetable kingdom.[82] The great anatomist and physiologist Herophilus is said to have called the plants "the hands of the gods."[83] This statement is not mere rhetoric. If nature is divine, the plants are divine too. Almost all physicians seem to agree with this. Some compose special remedies which are called sacred.[84] But Galen states in a more comprehensive sense: "One is right in saying that the plants act like the hands of the gods, since it is efficacious for the man who uses them to be trained in logical method and to have by nature a good understanding besides."[85] This interpretation which accepts the divinity of the plants because of the divinity of the intellect in the human being who applies them, is just as characteristic for the Greek attitude as the more verbal explanation of Herophilus' statement.

Undoubtedly rationalistic supernaturalism revives the old conception according to which the power of plants contains something

[82] Pliny, Naturalis Historia, XIX, finis.

[83] Scribonius Largus, Compositiones, ed. G. Helmreich, 1887, p. 1, 1-3: Herophilus fertur dixisse medicamenta divinas manus esse. Cf. Galen, Opera ed. Kühn, XII, p. 966; Plutarch, Quaest. Symp. IV, 1, 3, 663c., the same is told about Erasistratos. Cf. also Nicander, Theriaca, v. 7.

[84] In Galen's works those named as inventors of divine remedies are: Antipatros, XIII, p. 136; Andromachos, XIII, p. 126; Archigenes in Aetius, III, 114 (CMG, VIII, 1, 1935, p. 305, 11 sq.); in regard to Rufus cf. J. Ilberg, Rufus v. Ephesus, Abh. d. Sächs. Akademie, XLI, 1930, p. 20.

[85] Galen, Opera, ed. Kühn, XII, p. 966: *ἐάν τε πάλιν οἱόν περ θεῶν χεῖρας εἶναι τὰ φάρμακα καὶ τοῦτο ὀρθῶς ἐρεῖς. ἀνύει γὰρ μεγάλα τὸν χρώμενον αὐτοῖς ἔχοντα γεγυμνασμένον ἐν λογικῇ μεθόδῳ μετὰ τοῦ καὶ συνετὸν εἶναι φύσει.*

miraculous. But this does not mean the introduction of any magical belief. On the contrary, it hinders the acceptance of those ideas.[86] Galen expressly states that the Herophilean Andreas recorded magical rites to be used in connection with plants and that he was the first to discuss sorcery and such nonsense in medical books. Hippocrates, Euryphon, Dieuches, Diocles, Pleistonicus, Praxagoras, Herophilus, did not care for magical remedies. All the great pharmacologists, Crateuas, Heraclides of Tarent, Dioscurides, rejected those things. Andreas and Pamphylus and the men who followed them constituted a small minority; they were scholars rather than physicians; they were antiquaries.[87] These men, then, were an exception, they were isolated as were those who believed in the demonic character of diseases. And it is not venturous to assume that the same reasons by which the explanation of illness through demons was refused, were responsible also for the attitude of the physicians in pharmacology.

But all the pharmacologists, nay almost all the physicians, believed in sympathetic remedies. They are to be found in Dioscurides as well as in Galen, in the books of Stoic physicians and even of Methodists. Is this not the reception of magic into medicine, and the first sign of decay? For, the Hippocratic books are free of those remedies, and it is only from the Hellenistic time on that they begin to be used. However, the sympathetic effect, to the ancients is a natural phenomenon and proved by experiments, not by any magical theory. Even the Stoics understand it in this way and collect facts as proof

[86] The mysterious effect of plants, still intimated at least in the Homeric Epic, was soon forgotten. The term φάρμακον, since the 7th century B. C., had no longer any magical meaning (cf. W. Artelt, Studien z. Gesch. d. Begriffe Heilmittel u. Gift, Stud. z. Gesch. d. Medizin, herg. v. Karl Sudhoff, 23, 1937, pp. 46 sq.). When in the beginning of the Hellenistic era more plants, especially those of the Orient, became known to the Greek physician, a new and strong influx of magic took place. For in the Orient magical rites were combined with the plucking of plants as well as with their preparation and use; and Egypt is, already in the Homeric poem, famous for its remedies (Artelt, l. c., p. 44).

[87] Galen, Opera ed. Kühn, XI, p. 795. Concerning Andreas cf. F. Susemihl, Gesch. d. Griech. Literatur in der Alexandrinerzeit, I, 1891, p. 817, 231; II, 1892, p. 421, 32. It is because of the rejection of those things by the medical profession that they are to be found only in the magical papyri which contain not the knowledge of physicians but prescriptions of folklore. What Galen relates about Andreas corresponds with Papyri Graecae Magicae, ed. K. Preisendanz, I, 1928, p. 168-69; cf. also Rohde, Psyche, l. c., II, p. 87, 3.

of its reality, they do not rely on mere reasoning alone.[88] Unconvincing as the material seems to the modern it did convince even the Sceptics in antiquity. The only thing in the Stoic discussion that the Academic philosopher finds to agree with is the demonstration of sympathetic relations in the universe. For these are certain, although they must be explained, as the Sceptic believes, not by a divine spirit but by the spontaneity of nature.[89] Thus, from a teleological aspect as well as from a mechanical one sympathy is a reality.

That really experience is the basis of the judgment concerning the sympathetic or antipathetic effect, is shown by the opinion about amulets. Soranus, for instance, rejects the wearing of amulets because his experience does not confirm the good results which others claim to have observed. He once admits amulets because of their psychological influence.[90] In the same way Galen accepts that alone what according to his experience has proved to be helpful and leaves all the other things to those who are able to prove them by their experience.[91] Thus, physicians try very carefully to exclude every allusion to magic, they go no farther than their own experience leads. Nay, they are aware that the use of amulets is a very ambiguous means and almost beyond the realm of medicine. It is characteristic that even a physician of the 6th century A. D. prescribes amulets only in those cases in which "no remedy of the art still has power."[92] But since the aim of medicine is to make healthy and to

[88] Cf. E. Zeller, Die Philosophie d. Griech., III, 1[4], 1880, p. 169, 2: "Unter der Sympathie verstehen die Stoiker nicht den magischen Zusammenhang, welchen der neuere Sprachgebrauch mit diesem Wort bezeichnet, sondern das naturgemässe Zusammentreffen gewisser Vorgänge in den verschiedenen Teilen der Welt." Cf. also p. 237, 113.

[89] Cicero, De natura deorum, III, 11, 28: "Itaque illa mihi placebat oratio de convenientia consensuque naturae, quam quasi cognatione continuata conspirare dicebas, illud non probabam quod negabas id accidere potuisse nisi ea uno divino spiritu contineretur. Illa vero cohaeret et permanet naturae viribus non deorum, estque in ea iste quasi consensus, quem *συμπάθειαν* Graeci vocant; sed ea quo sua sponte maior est eo minus divina ratione fieri existimanda est."

[90] Soranus, CMG, IV, 1927, p. 47, 17; 121, 26.

[91] Galen, Opera, ed. Kühn, XII, p. 573.

[92] Alexander v. Tralles, ed. Puschmann, II, p. 319: *εἰ δὲ . . . μηδενὸς τῶν ἀπὸ τῆς τέχνης ἰσχύοντος . . . καὶ τοῖς φυσικοῖς περιάπτοις οὐδὲν ἄτοπον κεχρῆσθαι χάριν τοῦ σῶσαι τὸν κάμνοντα.*

overcome diseases, " it is wonderful to win in this struggle, and for that purpose to use everything which can possibly help," [93] everything which is within human experience.

Yet, certain as it is that experience proves the sympathetic effect, this experience can be had only on the presupposition of a specific theory. One must at least believe that it is possible to connect two phenomena which happen at the same time. Otherwise the coincidence of facts will be understood as fortuitous and not as purposeful. It is for this reason that the Empiric physicians do not recognize sympathy, that only the experience of the Dogmatists and of a few Sceptics who do not cling too strictly to their views recognizes the reality of these effects. The belief in a teleological power of nature is presupposed by the belief in sympathy.

It is in accordance therewith that sympathetic influences are first mentioned in the writings of Theophrastus on natural philosophy.[94] Theophrastus, although a Dogmatist and an Aristotelian, emphasizes the value of experience. He states that especially natural science, the objects of which are the bodies of the physical world, must start from experience; according to him it is perception which provides the material for human thought.[95] Thus, Theophrastus becomes interested also in things which are called fairy-tales by earlier thinkers. But he is the first who is unbiased enough not to think impossible from the outset what other people declared to be nonsense without any further inquiry. The discovery and utilization of

[93] Ibid., II, p. 474-75: καλὸν γὰρ νικᾶν καὶ πάσῃ μηχανῇ βοηθεῖν. Concerning the material preserved cf. L. Deubner, Greek charms and amulets, in Encyclopaedia of Religion and Ethics, ed. by J. Hastings, III, 1910, pp. 433-439.

[94] Theophrast, Opera, ed. F. Wimmer, III, 1862, p. 92 (On Odor 63), p. 218 (Fr. 172, 3); p. 133, sympathetic effects in the human body are described, comparable to those already known by the Hippocratic writers (cf. Jones, l. c., I, p. 351, On Nutriment, XXIII). In the ps-Aristotelian Problemata (Aristotle 886a 24 sq.) probably written in the time of Theophrastus, examples of sympathy are described too. E. Stemplinger, l. c., p. 7, names the Pythagoreans, Empedocles, and Plato as forerunners of Theophrastus. The conception of sympathy goes back certainly to the period before the 4th century B. C. But it is Theophrastus who gives sympathy its place in natural science. Since he acknowledges its effect apparently on account of philosophical argumentations it is not the Stoics who have the first system of sympathy (contrary to Stemplinger, l. c.).

[95] Cf. Zeller, l. c., II, 2, 1879, pp. 813-14 and Überweg-Prächter, Die Philosophie d. Alterums[12], 1926, p. 403, where the relation between Theophrastus and Strato is stressed.

sympathetic effects is a scientific advance not made until the 4th century B. C.[96] This fact explains why sympathetic remedies are still unknown to the Hippocratic physicians. Moreover, it shows that from the point of view of ancient medicine the use of such things cannot be determined as deviation from the true method. It is on a scientific principle quite different from that of magic that the use of sympathetic remedies is based in antiquity.

Later, with the rise of the Neo-Platonic philosophy and of the Christian religion, a change took place. The Neo-Platonists explained sympathy not by physical but by psychic causes.[97] What had been physical, thereby became spiritual. The Christian belief, on the other hand, separated God from nature; nature was no longer an animate being. Thus, effects which were in earlier times natural and empirical, later became mysterious. And since they were supposed to be mysterious they were looked upon with suspicion or were forgotten by the physicians. Theodorus Priscianus says in the beginning of his book on physical remedies: "Nature is everywhere performing a great mystery," but "you will forgive me my work, oh my forefathers. The crude generation of our times is ignorant of the procedure of your investigations."[98] And it is Alexander of Tralles, a

[96] Cf. Theophrastus, Inquiry into Plants, IX, 18, 4, 10; and in contrast to his statement Aristotle, History of Animals, 605a, 4-6, *τὰ δ' ἐπιμυθευόμενα πέπλασται μᾶλλον ὑπὸ γυναικῶν καὶ τῶν περὶ τὰς ἐκψδάς*. I cannot deal with the problem whether the 9th book of the Inquiry into Plants is genuine or not. H. Bretzl, Botanische Forschungen des Alexanderzuges, 1903, p. 366, denies the authenticity of the last part "dessen nicht theophrasteischen Geist jeder (Botaniker) beim ersten Durchlesen fühlt." Rehm und Vogel, Exakte Wissenschaften, l. c., 5, 57, agree with him. But G. Senn, Das pharmazeutisch-botanische Buch in Theophrast's Pflanzenkunde (Verhandlungen d. Schweizer Naturforschenden Gesellschaft, Zermatt, 1923, II. Teil, pp. 201-02), opposes this opinion just as a botanist. The material, at least is, according to him, genuine and the assumption of a "Pseudotheophrast" unnecessary. Manifold wordings of the book are now also proved by O. Regenbogen, Hermes 69, 1934, pp. 75 sq.; 190 sq., as far as the first books are concerned. Nothing indicates that the material even if it is not collected by Theophrastus himself, does not go back at least to his school. So much is certain, that the interest in sympathetic remedies is rather an indication in favor of Theophrastus than against him. The rejection of incantations and of superstition (IX, 19, 3) in general is also in accordance with the attitude of Theophrastus. At any rate, it is not justifiable to omit the passages concerning sympathetic remedies, as is done in the edition of A. Horst in the Loeb Classical Library, 1916, p. 310.

[97] E. Zeller, l. c., III, 2[3], 1881, p. 558.

[98] Theodorus Priscianus, Euporiston, ed. Valentin Rose, 1894, p. 250, 14: est enim

late physician of the decadent age, who states: "I should like to use all kinds of remedies, but because of the stupidity of the many of to-day who blame those who do it, I shrink from applying them." [99] The physician employing sympathetic remedies is now considered to be a sorcerer. In earlier centuries he was a scientist.[100]

In surgery, dietetics and pharmacology then Greek medicine is rational and hostile to magic. The same is true in regard to the use of music as a remedy for pains. The Sicilian physicians, like others, resorted to music as Caelius Aurelianus relates: "Others have approved of the use of songs as the brother of Philistion also remarks in the XXII book on remedies writing that a certain piper had played his melodies over parts of the body which, quivering and throbbing, were relaxed after the pain had been destroyed." [101] How this is to be understood becomes evident from the discussions of philosophers who were interested in the effect of music and from the judgment of Soranus about it. Gellius relates: "I ran across the statement very recently in the book of Theophrastus On Inspiration that many men have believed and put their belief on record, that when gouty pains in the hips are most severe they are relieved if a flute-player plays soothing measures. That snake-bites are cured by the music of the flute, when played skillfully and melodiously, is also

in omni mundo natura quae operetur grande secretum; 250, 17-20: dabitis mihi veniam operis, patres priores. disputationum enim vestrarum rationes . . . aetas mundi rudis ignoravit. Cf. Pliny, N. H. XIX, 186: opus occultum, the hidden work.

[99] Alexander v. Tralles, ed. Puschmann, I, 1878, p. 573: *ἐγὼ δὲ φιλῶ πᾶσι κεχρῆσθαι. διὰ δὲ τοὺς πολλοὺς τοὺς ἐν τῷ νῦν χρόνῳ ἀμαθεῖς ὄντας καταμέμφεσθαι τοῖς χρωμένοις τοῖς φυσικοῖς, ἔφυγον συνεχῶς χρῆσθαι τοῖς φόσει δρᾶν δυναμένοις. . . .*

[100] It is significant for the derivation of the sympathetic remedies from experience concerning natural facts that they are usually called *φυσικὰ* or *ἐμπειρικά*. My attention was first drawn to this fact by a lecture of O. Temkin on Magic and Experience in which he emphasized the significance of these expressions (cf. also M. Neuburger, Gesch. d. Medizin II, p. 26). It is again in the magical papyri that the mysterious character of those things occurs first, the derivation of the healing power from nature being stressed. Here too, for the first time nature is revered as a deity who is not identical with the god governing the world but a demon who performs miraculous effects. Cf. K. Preisendanz, Philologus, 67, 1908, p. 474.

[101] Caelius Aurelianus, De morbis acutis et chronicis, l. c., p. 555: "Alii cantilenas adhibendas probaverunt, ut etiam Philistionis frater idem memorat libro XXII, de adiutoriis scribens quendam fistulatorem loca dolentia decantasse, quaecum saltum sumerent palpitando, discusso dolore mitescerent."

stated in a book of Democritus, entitled On Deadly Infections, in which he shows that the music of the flute is medicine for many ills that flesh is heir to. So very close is the connection between the bodies and the minds of men, and therefore between physical and mental ailments and their remedies." [102] And Soranus asserts that those men were very stupid who believed that the strength of the illness can be expelled by melodies and songs.[103] There is no magical belief responsible for the use of music any more than magical powers are presupposed in the use of words. Diocles holds that one has to understand friendly consolation as incantation. For it stops the flowing of the blood when the wounded man is attentive and, as it were, connected with the man who speaks to him." [104]

At any rate in the administration of songs and in the use of words no magical belief is to be found. Every kind of incantation, too, is throughout antiquity rejected by physicians. In the Hippocratic book on the Sacred Disease it is said: "But perhaps what they profess (sc. in regard to incantations) is not true, the fact being that men, in need of a livelihood, contrive and devise many fictions of all sorts." [105] Galen declares all the incantations to be wrong.[106] Nay: "Animals like human beings can be cured not by vain words but by

[102] The Attic Nights of Aulus Gellius with an English Translation by J. C. Rolfe, Loeb Class. Library, 1927, I, p. 352-54: "Creditum hoc a plerisque esse et memoriae mandatum, ischia cum maxime doleant, tum, si modulis lenibus tibicen incinat, minui dolores, ego nuperrime in libro Theophrasti *περὶ ἐνθουσιασμοῦ* scriptum inveni. Viperarum morsibus tibicinium scite modulateque adhibitum mederi, refert etiam Democriti liber, qui inscribitur *περὶ λοιμῶν* in quo docet plurimis hominum morbidis medicinae fuisse incentiones tibiarum. Tanta prorsus adfinitas est corporibus hominum mentibusque et propterea vitiis quoque aut medellis animorum et corporum." It is by the expression modulis lenibus that the words *μαλακαῖς ἐπαοιδαῖς* in Pindar's Ode must be interpreted, cf. also Theophrast, fr. LXXXVII, Wimmer: *Ὅτι δὲ καὶ νόσους ἰᾶται μουσικὴ Θ. ἱστόρησεν ἐν τῷ περὶ ἐνθουσιασμοῦ, ἰσχιακοὺς φάσκων ἀνόσους διατελεῖν εἰ καταυλήσοι τις τοῦ τόπου τῇ φρυγιστὶ ἁρμονίᾳ.* Sometimes the invention of this procedure was ascribed to Pythagoras, cf. Caelius Aurelianus, l. c.: Alii denique hoc adjutorii genus Pythagoram memorant invenisse."

[103] Caelius Aurelianus, l. c.: "Sed Sorani iudicio videntur hi mentis vanitate iactari, qui modulis et cantilena passionis robur excludi posse crediderunt."

[104] Diocles, Fr. 92, Wellmann: *Διοκλῆς ἐπαοιδὴν παρέδωκε τὴν παρηγορίαν. ἰσχαιμον γὰρ εἶναι ταύτην, ὅταν τὸ πνεῦμα τοῦ τετρωμένου προσεχὲς ᾖ καὶ ὥσπερ προσηρτημένον τῷ παρηγοροῦντι.*

[105] Jones, l. c., II, p. 147: *ἴσως δὲ οὐχ οὕτως ἔχει ταῦτα, ἀλλ' ἄνθρωποι βίου δεόμενοι πολλὰ καὶ παντοῖα τεχνῶνται.*

[106] Galen, Opera, ed. Kühn, XI, p. 792.

the reliable art of healing." [107] And in this respect the attitude of the Romans does not vary from that of the Greeks. For Celsus does not advise incantations, either, Varro warns against their use. The Roman law does not recognize as true physicians men who perform incantations.[108]

To be sure, incantations were never a means of the physician. The decadent age is in this respect not different from the 5th century B. C.[109] Incantations are not only useless, and wrong, says

[107] Vegetius, ed. E. Lommatzsch, 1903, p. 199, 1-4: Aliquanti praecantatione tentant afferre remedia; quae vanitas ab aniculis solis diligenda est, cum animalia sicut homines non inanibus verbis sed certa medendi arte curentur (this general statement proves that the two incantations which are found in the text must be later additions, p. 306, 5-8; 10-11. The hostile attitude toward those remedies is confirmed p. 65, 3-5; 10-12.) Also in Gargilius Martialis only one incantation is mentioned (l. c., p. 309, 12 sq.). In the Mulomedicina Chironis, ed. E. Oder, 1901, p. 62, 7-10, incantations are rejected too. (Two exceptions p. 260, 4; p. 285, 4.) In Paelagonius, ed. M. Ihm, 1892, p. 90, 1, the incantation which is rejected by Vegetius (l. c., p. 199, 1-4) is given in detail. But the situation even in veterinary medicine is characterized by the remark of the editor of Paelagonius (§ 121, p. 154): "Utinam is qui Graeca hippiatrica congessit superstitiosor fuisset. Removit enim fere omnia harum superstitionum exempla, quibus Apsyrti liber refertus fuisse videtur. Unus codex Parisinus Milleri nonnulla servavit obscure scripta . . . Paelagoniana huius generis alia mox sequentur, quae ne Vegetio quidem digna visa sunt quae reciperentur. Immo is tamquam detrectatorem et contemptorem se iactat . . . etsi apud veteres magno in honore fuerint, ut vel Catonis . . . cantatio barbara testatur." One can only conclude that it is really impossible to ascribe to ancient physicians, not even to veterinaries the use of incantations.

[108] Cf. Varro, Catus (Mommsen, Röm. Gesch. III[8], 1875, p. 610). Digesten L, 13, 1. § 3 (The physician has the right to sue for his salary) non tamen si incantavit, si inprecatus est, si ut vulgari verbo impostorum utar, exorcizavit. non sunt ista medicinae genera, tametsi sint, qui hos sibi profuisse praedicatione adfirment. Cato, usually quoted for the Roman use of incantations, is not the only witness and his testimony has no value for the time in which Greek medicine was influential in Rome.

[109] The passages quoted above concerning the use of music are usually referred to as proof for the use of incantations in Greek medicine, cf. Wellman, Die Fragmente d. Sizilischen Ärzte, 1901, p. 30a: "Ihr Heilverfahren . . . bestand, in Besprechungen . . . Beachtenswert ist ferner, dass Diokles gleichfalls ein Anhänger jener Schule die ἐπαοιδαί zur Stillung des Blutes bei Wunden empfohlen . . . Es ist wahrscheinlich, dass die sikelische Schule diese populären Mittel der Volksmedizin aus pythagoreischer Lehre herübergenommen hat." Or it is said (RE, Suppl. IV, s. v. Epode, pp. 340-41): "Der Gebrauch der Epode ist in der antiken Welt nie geschwunden trotz der Gegner, die dagegen bei den Griechen selbst und bei den Christen auftraten. Schon im 5. Jahrhundert finden wir solche bei den Ärzten . . . Von späteren Ärzten welche ihren Gebrauch verwarfen, seien etwa Soranus . . . und Galen . . . genannt . . . aber diese Stimmen drangen nicht durch, da die

Galen, they are outside of the activity of the physician.[110] No one can perform incantations if he wants to be acknowledged as a good doctor: "It is not a learned physician who sings incantations over pains which should be cured by cutting." [111] This attitude does not signify a progress reached only in the time of the Hippocratic physicians. Homeric medicine is already opposed to such means, and the polemic of the book on the Sacred Disease only proves that in the 5th century B. C. problems must be discussed which before were not worth discussing.[112]

The rejection of incantations was the more difficult since not even those who trusted their validity claimed to have a reason by which their effect could be explained.[113] The men who performed incantations were priests, and even Plato admits that for the many it is not easy to come to a definite conclusion concerning the value of incantations.[114] But the Olympian religion remains strong enough to resist Only the superstitious resort to incantations. A believer in magic may dare to state that disbelief in incantations proves disbelief in God; but even in the 2nd century A. D. the answer is that this conclusion is rash, that, on the contrary, men who believe they can force God by their prayers are impious, as they were called also in the book on the Sacred Disease.[115] It is not until the old religious feeling was weakened that foreign rites and superstition could get the upper hand. And it is important to note that Asclepius, the patron of physicians and patients, was for all pious men of these late centuries

volkstümliche Verwendung der Epoden von Anfang an auch von Ärzten oder solchen die dafür galten, übernommen wurde." Cf. also F. G. Welcker, Kl. Schriften, III, 1850, pp. 68 sq. I think it is sufficient to give the passages in full in order to prove that they have no magical implications whatsoever.

[110] Galen, Opera, ed. Kühn, XI, 792: *μαγγανείαι οὐ περίεργοι μόνον, οὐδ' ἔξω τῆς ἰατρικῆς τέχνης, ἀλλὰ καὶ ψευδεῖς ἁπάσαι.*

[111] Sophocles, Aias, 581-82: *οὐ πρὸς ἰατροῦ σοφοῦ θρηνεῖν ἐτῴδὰς πρὸς τομῶντι πήματι.*

[112] Contrary to Wilamowitz, Der Glaube der Hellenen, I, 1931, p. 29 (*Schon* im 5ten Jahrhundert) and Jones, l. c., I, p. 10.

[113] Alexander v. Aphrodisias, De Fato, cp. 8, Supplementum Aristotelicum, II, 2, 1881, p. 174, 20-25: *ἄδηλα δὲ τὰ αἴτια ἀνθρωπίνῳ λογισμῷ ἐκείνων μᾶλλον ἃ κατά τινας ἀντιπαθείας γίνεσθαι πεπίστευται ἀγνοουμένης τῆς αἰτίας δι' ἣν γίνεται, ὁποῖα περίαπτά τέ τινα προσείληπται οὐδεμίαν εὔλογον καὶ πιθανὴν αἰτίαν τοῦ ταῦτα ποιεῖν ἔχοντα, ἔτι δὲ ἀπαιδαί καί τινες τοιαῦται μαγγανεῖαι. τούτων γὰρ ὁμολογεῖται μὲν ὑπὸ πάντων ἄδηλος εἶναι ἡ αἰτία, διὸ καὶ ἀναιτιολόγητα λέγουσιν αὐτά.* Not only incantations but all the other magical procedures are then justified by their empirical efficacy.

[114] Laws, XI, 933a.

[115] Lucian, Philopseudes, 29.

the symbol of Olympian religion.[116] If in antiquity nobody doubted that magic had its origin in medicine as Pliny relates,[117] the medical art of the Greeks and Romans has really freed itself from any magical ingredient. And this in spite of the necessary temptation to use everything which may help to cure the patient and in spite of the supposed empirical confirmation of the power of incantations. For even in the latest centuries it is on the efficacy of incantations in those cases in which the other remedies fail, that their use is based and excused. For the superstitious physicians themselves never forget that in performing incantations they transgress the limits of medicine.[117a]

But what about the relation of physicians to the religious healing of diseases? What do they think about prayers and incubations which were supposed by many people to help against illness in the same way as surgery and dietetics, remedies and music?

Prayers are not dealt with very often in medical books. In one of the Hippocratic writings it is said: "Prayer indeed is good, but while calling on the gods a man should himself lend a hand."[118] This is not an ironical statement, for the same author declares:

[116] Harnack, Medizinisches aus d. ältesten Kirchengeschichte, l. c., p. 72: "Das eigentümliche des Dämonenglaubens im 2. Jahrhundert besteht erstlich darin, dass er aus den dunklen unteren Schichten in die oberen, selbst in die Literatur, emporgedrungt und eine ungleich wichtigere Sache wird wie ehedem, zweitens, dass er keine kräftige naive öffenliche Religion mehr neben sich hat, die ihn niederhält . . . Die ausserordentliche Verbreitung des Dämonenglaubens . . . (ist darauf) zurückzuführen, dass in der Kaiserzeit das Zutrauen zu den alten Religionen dahinschwand . . ." Concerning the foreign origin of incantations cf. e. g., Diodor, II, 39 (the Chaldeans), III, 58 (Cybele), Lucian, Demonax, cp. 23.

[117] Pliny, Naturalis Historia, XXX, 1: magicam natam primum e medicina nemo dubitat. But Pliny himself admits that incantations were rejected by the wisest (l. c., XVIII, 3-4).

[117a] Cf. Alexander v. Tralles, l. c., II, 1879, p. 475 (the explanation of the supposed change of Galen's opinion concerning incantations); p. 579; p. 585. In this sense it must be understood that Ammianus Marcellinus (Res Gestae, XVI, 8, 2) speaks of an "anile incantamentium . . . quod medicinae quoque auctoritas admittit." Concerning the material preserved cf. again L. Deubner, Greek charms and amulets, l. c.

[118] Jones, l. c., IV, p. 423: *καὶ τὸ μὲν εὔχεσθαι ἀγαθόν. δεῖ δὲ καὶ αὐτὸν συλλαμβάνοντα τοὺς θεοὺς ἐπικαλεῖσθαι.* Cf. p. 447: "I have discovered regimen, with the gods' help, as far as it is possible for mere man to discover it." Withington's opinion that the book shows an irreligious attitude is certainly incorrect, l. c., p. 142.

"So with this knowledge . . . precautions must be taken, with change of regimen and prayers to the gods . . . that all dangers may be averted." [119] He firmly believes then, in the power of prayers, although he thinks it necessary not to rely on them alone where other means are available too. In the same way the efficacy of prayers is presupposed in another Hippocratic treatise which refutes the theory that a certain disease can be understood as holy. For "if we suppose this disease to be more divine than any other, it ought to have attacked, not the highest and richest classes only of the Scythians, but all classes equally—or rather the poor especially, if indeed the gods are pleased to receive from men respect and worship, and repay these with favours. For naturally the rich, having great wealth, make many sacrifices to the gods, and offer many votive offerings, and honor them, all of which things the poor, owing to their poverty, are less able to do; besides, they blame the gods for not giving them wealth, so that the penalties for such sins are likely to be paid by the poor rather than by the rich." [120] The belief that god would benefit rich people more than poor ones because he receives greater offerings from them is at least the basis of this argument. There is no reason to assume that the Hippocratic physicians are opposed to the validity of prayers.

At a later time no discussion of prayers is found in medical books, Galen holding that it is better to recognize the power of God by understanding the world than by sacrifice.[121] This reticence concerning prayers or even their renunciation does not involve, however, any hostility to religion; it is in accordance with the attitude of the philosophers and with that of pious men in general. From Socrates on it is held to be offensive rather than reverent to ask favours of the gods. The pious man is allowed only to express his gratitude;

[119] Jones, l. c., IV, p. 437: *οὕτω γινώσκοντα χρὴ προμηθεῖσθαι καὶ ἐκδιαιτᾶσθαι καὶ τοῖσι θεοῖσιν εὔχεσθαι . . . ἀποτρόπαια τὰ χαλεπὰ εἶναι πάντα.*

[120] Jones, l. c., I, p. 129: *καίτοι ἐχρῆν, ἐπεὶ θειότερον τοῦτο τὸ νόσευμα τῶν λοιπῶν ἐστιν, οὐ τοῖς γενναιοτάτοις τῶν Σκυθέων καὶ τοῖς πλουσιωτάτοις προσπίπτειν μούνοις, ἀλλὰ τοῖς ἅπασιν ὁμοίως, καὶ μᾶλλον τοῖσιν ὀλίγα κεκτημένοισιν, εἰ δὴ τιμώμενοι χαίρουσιν οἱ θεοὶ καὶ θαυμαζόμενοι ὑπ' ἀνθρώπων καὶ ἀντὶ τούτων χάριτας ἀποδιδόασιν. εἰκὸς γὰρ τοὺς μὲν πλουσίους θύειν πολλὰ τοῖς θεοῖς καὶ ἀνατιθέναι ἀναθήματα ἐόντων χρημάτων πολλῶν καὶ τιμᾶν, τοὺς δὲ πένητας ἧσσον διὰ τὸ μὴ ἔχειν, ἔπειτα καὶ ἐπιμεμφομένους ὅτι οὐ διδόασι χρήματα αὐτοῖσιν, ὥστε τῶν τοιούτων ἁμαρτιῶν τὰς ζημίας τοὺς ὀλίγα κεκτημένους φέρειν μᾶλλον ἢ τοὺς πλουσίους.*

[121] Galen, De usu partium, l. c., cf. p. 216, 44.

he may thank but can do no more.[122] The physicians, in adopting this attitude, follow the development of the religious feeling among the Greeks.

At the same period incubations have become the more recognized form of religious healing; they have replaced prayer which is no more an adequate procedure. These incubations are dream-healings: either the way of curing is revealed to the patient or he is cured immediately by the god. Now, as regards mantic dreams, most of the physicians of all centuries admit their reality; they acknowledge even their divine character. In the Hippocratic Corpus "those dreams being divine and foretelling to cities or to private persons things evil or things good" are expressly named.[123] Herophilus distinguishes dreams sent by God from those which are natural. The Empiricists too reckon with the divinity of dreams; Rufus recounts such dreams as does Galen.[124] The Methodists are the only physicians who apparently do not believe in divine dreams; they never mention them. However, it seems justifiable to state that the great majority of Greek physicians recognize the divinity of dreams. And this is not at all astonishing, for almost all Greek philosophers did the same. Epicurus alone objects to such a theory, and it must be on account of Epicurean influence that the Methodists are the only physicians to disapprove of the value of mantic.[125]

Divine dreams are at first held to be unintelligible to physicians although dreams caused by physical factors can be interpreted by them. The Hippocratic author says: "such dreams as are divine have interpreters in those who possess the art of dealing with such things," namely in the priests.[126] Only the physical dreams are to be

[122] Cf. J. Bernays, l. c., pp. 104-105. Diogenes Laertius VII, 124 is heretical.

[123] Jones, l. c., IV, p. 423: *Ὁκόσα μὲν οὖν τῶν ἐνυπνίων θειά ἐστι καὶ προσημαίνει ἢ πόλεσι ἢ ἰδιώτῃσι ἢ κακὰ ἢ ἀγαθά.*

[124] Herophilus: Doxographi Graeci, 416, 14-22; Empiricists: Deichgräber, Die Griech. Empirikerschule, 1930, p. 78, 28; 95, 8; 149, 24; 150, 12; Rufus: Oribasius, III (CMG VI, 6, 1, 1931, p. 192, 3 sq.); Galen, Opera, ed. Kühn, XI, p. 341; XVI, p. 221; Asclepiades: Galen, Opera, ed. Kühn, II, p. 29.

[125] Cf. Cicero, De Divinatione, I, 5-6, where it is said that even Democritus adopted the belief in dreams. Concerning Pythagoras cf. Diogenes Laertius, VIII, 32; concerning the Stoa also Doxographi Graeci, p. 416, 10. Xenophanes and Epicurus resist the dogma. The old Academy acknowledged it, the new Academy was undecided in its judgment as was Panaetius (cf. Herzog, Die Wunderheilungen v. Epidaurus, l. c., p. 61).

[126] Jones, l. c., IV, p. 423.

interpreted by physicians: "All the physical symptoms foretold by the soul, excess, of surfeit or of depletion, of things natural, or change to unaccustomed things, these also the diviners interpret, sometimes with sometimes without success. But in neither case do they know the cause, either of their success or of their failure. They recommend precautions to be taken to prevent harm, yet they give no instruction how to take precautions, but only recommend prayers to the gods." [127] Thus part of the realm of the diviners is in the 5th and 4th centuries B. C. usurped by the physicians and declared to be their own. But the priests are still the only interpreters of divine dreams.

Yet later on also physicians do interpret the divine dreams as well as the physical ones. The Empiricists and Galen do not ask the diviners about the contents of dreams, they understand them by themselves. This type of divination becomes a science of its own, and now "the divine prescriptions are simple and have nothing mysterious . . . , they fall within medical reasoning.[128] At the same time a change in the theoretical understanding of dreams takes place. In the Hippocratic book, although it is the soul which tells beforehand what will happen, it is the body which causes the dreams.[129] But Herophilus declares dreams to be merely psychological phenomena; it is not the bodily changes but only the psychic changes that are manifested in dreams; these are the natural dreams which have to be separated from the divine.[130] His theory comes to be generally recognized even by the diviners. The book of Artemidoros, which is the most famous treatise on the interpretation of dreams, takes over its theory almost verbally from Herophilus.[131]

[127] Jones, l. c., IV, p. 423: *ὁκόσα δὲ ἡ ψυχὴ τοῦ σώματος παθήματα προσημαίνει, πλησμονῆς ἢ κενώσιος ὑπερβολὴν τῶν συμφυτῶν ἢ μεταβολὴν τῶν ἀηθέων, κρίνουσι μὲν καὶ ταῦτα, καὶ τὰ μὲν τυγχάνουσι, τὰ δὲ ἁμαρτάνουσι, καὶ οὐδέτερα τούτων γινώσκουσι δι' ὅ τι γίνεται, οὐθ' ὅ τι ἂν ἐπιτύχωσιν οὐθ' ὅ τι ἂν ἁμάρτωσι, φυλάσσεσθαι δὲ παραινέοντες μή τι κακὸν λάβῃ. οἱ δ' οὖν οὐ διδάσκουσιν ὡς χρὴ φυλάσσεσθαι, ἀλλὰ θεοῖσιν εὔχεσθαι κελεύουσι.*

[128] Artemidoros, Oneirocritos, ed. R. Hercher, 1864, p. 215, 1 sq.: *τὰς δὲ συνταγὰς τῶν θεῶν ἤτοι ἁπλᾶς καὶ οὐδὲν ἐχούσας αἴνιγμα εὑρήσεις.* Cf. in general A. Bouché-Leclerq, Histoire de la divination dans l'antiquité, I, 1879, pp. 295 sq.

[129] Jones, l. c., IV, p. 420.

[130] Herophilus, l. c., 416, 14: *Ἡρόφιλος τῶν ὀνείρων τοὺς μὲν θεοπέμπτους καθ' ἀνάγκην γίνεσθαι, τοὺς δὲ φυσικοὺς ἀνειδωλοποιουμένης ψυχῆς τὸ συμφέρον αὐτῇ καὶ τὸ πάντως ἐσόμενον . . .*

[131] Cf. Bouché-Leclerq, l. c., I, p. 297, who gives a thorough analysis of the book

What are the reasons for the belief in the validity of dreams? They are partly philosophical but differ according to the various systems.[132] Yet the fact that the Empiricists also acknowledge the reality of divine dreams already indicates empirical proof too, for this school has no other valid principle. Accordingly it is sometimes expressly stated that " some dreams are prophetic for this is shown by experiment." [133] Nay, even the dream-interpreters rely on experience rather than on argument. They say that the validity of dreams can hardly be proved by reason but that it can be shown by experience.[134] Dreams, to the ancients, are a natural phenomenon even when they are considered to be divine and as such they belong to natural science. There is then no reason for the scientific physician to object to healing by priests according to advice given in temple dreams.

But the physicians could not object to the miracles performed by the god either. For ancient dogmatic philosophy acknowledges the possibility of miracles. This depends on the fact that the natural laws are not held valid by the Dogmatists in every case but only in most cases. Exceptions are then always possible; things may happen for reasons still unknown, but they are not at all contrary to nature. Aristotle says: " It is the miracle, a thing contrary to nature but not contrary to nature as a whole, rather contrary to it as it appears in most cases. For in regard to the eternal nature which acts with necessity nothing comes into being contrary to it." [135] This sentence is valid for later generations too. Also the Stoic philosophers and

of Artemidorus and also names all the physicians and philosophers interested in the theory of dreams.

[132] Cf. e. g., Aristotle, On Dreams and p. 240, 125.

[133] Galen, Opera, ed. Kühn, VI, p. 833: *καὶ δή τινα μαντικῶς ὑπ' αὐτῆς* (sc. *τῆς ψυχῆς*) *προδηλοῦνται, καὶ γὰρ τοῦτο τῇ πείρᾳ μαρτυρεῖται.*

[134] Artemidorus, l. c., p. 1, 11; 15-16 . . . *περὶ ὧν ἂν ἔχω καταλῆψιν, ἣν διὰ πείρας ἐπορισάμην, συγγράψαι . . . φέρων εἰς τὸ μέσον τὴν πεῖραν καὶ τὴν τῶν ἀποτελεσμάτων μαρτυρίαν, ἣ πᾶσιν ἱκανὴ γένοιτ' ἂν ἀντισχεῖν ἀνθρώποις, καὶ μέντοι καὶ πρὸς τοὺς χρωμένους μὲν μαντικῇ διὰ δὲ τὸ μὴ ἐντετυχηκέναι λόγοις περὶ τούτων ἀκριβέσι πεπλανημένους.* Cf. p. 197, 12; 198, 14; 199, 1. Just because of their experimental basis dream-interpretations must not be identified with magic. Artemidoros therefore rejects every kind of magical belief and opposes magicians no less than do the doctors. Cf. p. 205, 25-206, 11.

[135] Aristotle, On the Generation of Animals, IV, 4, 770b9. *ἔστι γὰρ τὸ τέρας τῶν παρὰ φύσιν τι, παρὰ φύσιν δ' οὐ πᾶσαν ἀλλὰ τὴν ὡς ἐπὶ τὸ πολύ. περὶ γὰρ τὴν ἀεὶ καὶ τὴν ἐξ ἀνάγκης οὐθὲν γίνεται παρὰ φύσιν.* Cf. Zeller, l. c., II, 2[3], p. 429, 3.

the Neo-Platonists are able to understand miracles as nothing more than events whose causes are unknown. Dogmatic medicine, then, based on rational philosophy cannot oppose religious cures; miracles are not excluded by its conception of science. The Empiricists, on the other hand, cannot disapprove of miracles since they acknowledge no general rules beyond experience. There is no sufficient reason to allow them to contradict those facts. Only the Epicureans who try to explain everything and do not acknowledge the assumption that something can happen without an intelligible reason are opposed to miracles.[186] Therefore, the Methodists, the physicians of late antiquity who were especially influential in Roman centuries, are the only ones who must reject religious medicine as well as magical medicine. But in general, physicians, as scientists, believe in miracles.

But doctors never expressly advise the use of prayers or of incubations.[187] It is possible only to infer from their theory that they must have acknowledged the validity of prayers and of dreams. This conclusion leads to a very strange problem. If religious medicine cannot be rejected by physicians, is it considered to be valuable in certain cases? And in which cases? Or is it that physicians only believe it possible to be cured by divine help but that they do not

[186] Cf. Zeller, l. c., V, p. 697, 6; 704; 720. Dilthey (Das natürliche System der Geisteswissenschaften im 17. Jahrhundert, Gesammelte Schriften, II, 1923, p. 132) stresses the point that miracles could not be entirely discarded until the system of Descartes. The "Begriff von der ausnahmslosen Macht und Geltung der Naturgesetze . . . entstand erst, als durch Descartes alle psychischen Kräfte aus der Natur vertrieben worden waren." Concerning Epicurus cf. Lucretius, De Rerum Natura, I, v. 150-54.

[187] R. Herzog, Die Wunderheilungen v. Epidaurus, Philologus, l. c., p. 149; p. 61, believes, along with others, that the passage to be found in the book on Sacred Disease: *θύειν τε καὶ εὔχεσθαι καὶ ἐς τὰ ἱερὰ φέροντας ἱκετεύειν τοὺς θεούς* (Jones, l. c., II, p. 148) "auf die Incubation hinweise." Such an interpretation, however, spoils the argument used by the Hippocratic author. He has claimed that the patients if really possessed by god, should not be purified; he adds "one should rather if such patients are to be found pray to the gods and bring them to the temples." For it is his belief that the possession by god, since it is divine, should not be driven away but revered. The Scythians behaved similarly for they revered those men who were possessed by a god (cf. Jones, l. c., I, p. 127). If incubations were advised by the author this would mean a kind of healing which is necessary only if such men are ill, a contention which the author starting from the presuppositions of his enemies tries to refute. The healing of diseases by prayer alone was not recommended before Christian times, cf. Epistle of Jacobus, ch. V, 4, 5, 16; The Acts, ch. XL, 20; ch. V, 15.

resort to it themselves? This would be strange too. But there is no indication to be found in the medical writings as to when patients should use religious medicine and when they should use human medicine. At least, there is no direct indication. Indirectly, I think, it can be deduced from the facts upon what occasions the physicians themselves allow their patients to go to the temple: It is the case of chronic diseases or of every disease which cannot be cured by human knowledge.

The negative attitude of the Greek physicians in many diseases has always been felt to be puzzling. They seemed to be satisfied with the statement that such and such a man can be helped no more. They advised against treating patients who cannot be cured, and believed it to be part of their art both to know in what cases the physician cannot accomplish anything and, in those cases, to refrain from doing anything. This, no doubt, is a very peculiar, even inhuman behaviour. For it excludes the help of the physician in diseases which are gravest and in which his help is most needed. But such an attitude becomes immediately intelligible if the physician presupposes that the patient, if not treated by him, will go to the temple.

When the art of the physician fails, everybody resorts to incantations and prayers;[188] this phrase was frequently quoted in antiquity. It is especially true in chronic diseases, as it is said: "Those who are ill with chronic diseases and do not succeed by the usual remedies and the customary diet turn to purifications and amulets and dreams."[189] For, of course, one will not go to the god if the case is not serious. Therefore it is a topic of the temple-cures

[188] Diodorus, Fr., XXX, 43. Dindorf: *ἐκεῖνοί τε γὰρ [οἱ ἐν ταῖς μακραῖς νόσοις δυσποτμοῦντες] ὅταν ταῖς παρὰ τῶν ἰατρῶν θεραπείαις ὑπακούσαντες μηδὲν βέλτιον ἀπαλλάττωσι καταφεύγουσιν ἐπὶ τοὺς θύτας καὶ μάντεις, ἔνιοι δὲ προσδέχονται τὰς ἐπῳδὰς καὶ παντοδαπὰ γένη περιάπτων.* Cf. Pliny, N. H., XXX, 98.

[189] Plutarch, De Facie in orbe Lunae, 920b: *οἱ ἐν νοσήμασι χρονίοις πρὸς τὰ κοινὰ βοηθήματα καὶ τὰς συνήθεις διαίτας ἀνειπόντες ἐπὶ καθαρμοὺς καὶ περίαπτα καὶ ὀνείρους τρέπονται.* Cf. the stories related about Pericles (Plutarch, Pericles, ch. 38), Bion (Diogenes Laertius, IV, 54), Cleomenes (Plutarch, Sayings of Spartans, 223 E) which prove that this attitude is not restricted to the lower classes or to any century. It is the general reaction of men (contrary to Rohde, l. c., p. 89 and Welcker, l. c., p. 69). Since the physicians did not acknowledge magical help to be possible, they were the more interested in that their patients resorted to religious medicine.

that the god could help when the physicians could not.[140] In a world in which the temples of Asclepius are open to everybody who is ill it need not be mentioned that the patient can and should go to the god if the human physician cannot do anything for him. It is sufficient to state in which cases the physician can do no more. The consequence that the patient then should try to find help with the god is self-evident and removes the responsibility of the physician, as it relieves his conscience. This, at least, is true in so far as the physician has no ground for objecting to the healing by the god, since he acknowledges divine cures as real and helpful. It is not by chance, then, that the Methodists were the first to treat chronic diseases regularly; they were the only physicians who objected to the possibility of divine interference. But in general, religious medicine is, throughout antiquity, a subsidiary of human healing by surgery, diet, drugs, and music.

To sum up the results of my inquiry: Greek medicine in its aetiology as well as in its treatment of diseases is rational and empirical. About this fact there can be no doubt. But this is Greek rationalism and empiricism: it is influenced by religious ideas. God and His action are powers reckoned with by the physicians in their theory and in their practice. Every form of magic, however, is rejected as useless and wrong. If it is explained at all, it is on account of a religious belief that the physicians renounce magical superstition. Certainly, in many cases the Sceptic in his resignation also refrains from magical ideas. But this resignation, then, is not restricted to the renunciation of magic alone. It means also the

[140] Cf. Weinreich, Antike Heilungswunder, l. c., p. 195 sq. "Zur Topik der Wundererzählung, die Kunst der Ärzte versagt." A survey on incantations and the diseases in which they are used also shows that they are especially relied on in chronic diseases. Herzog, in his commentary to the tablets of Epidaurus (Die Wunderheilungen v. Epidaurus, l. c.) expressly mentions that the diseases cured by the god are those which are not or cannot be cured by human physicians. Later, when the chronic diseases are also treated by physicians, the religious incubations are more restricted to the revelation of remedies, and the type of illnesses dealt with in the temples changes (Weinreich, l. c., pp. 113 sq.). Still, the god performs miracles as in the case described by Rufus, cf. p. 240, 124 and in this sense religious medicine of course could never be replaced by human medicine. For, as Rufus says: "If somebody were so good a physician that he could provoke fever (as the god can), there would be no need for any other procedure of healing."

disapproval of every aetiology and is therefore destructive of medical science. Moreover, the majority of physicians belong to the Dogmatic school. The Dogmatists and the unknown practitioners are religious and hostile to magic which is held to be superstition. From the beginning till the end of antiquity there is no change in the attitude of the physicians in this respect. The relation of medicine to religion and magic therefore, cannot be used for distinguishing different epochs of medical history. Greek medical art is a science, it is the beginning of modern science and yet different from it in its foundation.

# GUILLAUME ADER AND HIS CONTRIBUTION TO BIBLICAL MEDICINE

OWSEI TEMKIN

The interpretation of the diseases and miraculous cures related in the Bible has always formed an essential part of theological studies and, due to the theological rather than medical interests of the middle-ages, it was the theologians rather than the physicians who treated the subject during that period. It is only from the 16th century on that we find an increasing number of medical authors [1] and the "Enarrationes de aegrotis et morbis in Evangelio" published by Guillaume Ader in 1620 is, therefore, one of the early forerunners of such famous works as Thomas Bartholinus' "De morbis biblicis" and Richard Mead's "Medica sacra."

As a physician Ader has been almost entirely forgotten,[1a] but as a poet he has retained some fame, chiefly owing to the fact that his poetry was written in the patois of Gascony, of which he was a native. "Lou Gentilome Gascoun," written in honour of the great Gascon, Henry IV, describes in vivid language the training, virtues and deeds of the ideal Gascon nobleman. "Lou Catounet Gascoun" derives its name from the elder Cato to whom the middle-ages attributed a collection of Latin distichs. Its 100 quatrains give moral advice suitable for the everyday life of the farmers and middle-classes of Gascony. Both poems have been studied by various authors [2] and have been edited together with a French translation by A. Vignaux and A. Jeanroy.[3] What little we know about the

[1] Io. Alberti Fabricii Bibliographia antiquaria etc., Vol. I, 3rd ed., Hamburgi 1760, p. 503: ". . . plura sacrarum litterarum loca ex Medicorum et Physicorum, Mathematicorumque observationibus illustrantur, quod institutum pridem fuit Franciscii Vallesii Covarruviani Medici, libro de sacra Philosophia, sive de iis quae scripta sunt Physice in libris sacris, Lugd. 1588, 1595, 8vo."

[1a] For older appreciations of Ader, cf. e. g., Haller, Bibliotheca medicinae practicae, T. II, p. 492 f.

[2] For bibliography cf. article Ader, Guillaume, in "Dictionnaire de Biographie Française," T. I, Paris 1932, col. 567 ff.

[3] Poésies de Guillaume Ader, publiées avec notice, traduction et notes (Bibliothèque Méridionale, Ire série, Tome IX), Toulouse-Paris, 1904. Unfortunately, the book of J. Michelet, Poètes gascons du Gers, Auch 1904, was not available to me.

life of Ader is chiefly due to the efforts of his modern literary interpreters.

Guillaume Ader was born in or near Lombez,[4] a small town in the département du Gers, in approximately 1569.[5] In 1587 we find him in Toulouse where, under the date of March 25th, he is mentioned as a student on a register of the "Blue Penitents" of Toulouse, a religious confraternity.[6] At the same time he must have studied medicine in Montpellier, for he refers to "Hucherius praeceptor noster Monspeliensis,"[7] while in 1590-91, Mercerius, the physician of the Cardinal Joyeuse, was his teacher and under his guidance he had an opportunity of studying an epidemic then ravaging the country.[8] It is therefore most probable that he studied at both universities but neither the date nor the place of his graduation is known.

Ader married one Magdelaine de Lux and it seems as if his life had been divided between Toulouse and Gimont a town not far away from his native Lombez. As early as 1603 a daughter of his was baptized at Gimont and, in 1608 a son, Pierre.[9] In the same year he was called in by the magistrate of the town to examine the body of a man suspected of having died of the plague.[10] In later years,

[4] There has been some dispute whether he was born at Lombez or at Gimont. Vignaux, l. c., p. xxxvii, considers a passage in the Gentilome Gascoun where Ader calls Lombez his dear country, decisive. This thesis, proposed by J.-B. Noulet, Essai sur l'histoire littéraire des patois du midi de la France aux XVIe et XVIIe siècles, Paris, 1859, p. 49, is further supported by p. 413 of Ader's Enarrationes where he says with reference to two patients: "Unus eorum erat Lumberiis, in charissima patria mea." It is probably with reference to this passage that Haller, l. c., says: "ex pago Lombieres."

[5] In the preface to his Enarrationes, probably written in 1619, Ader says: "si quid artis per triginta annos Medicinam discendo, docendo, faciendoque ingeniolo nostro comparatum est" which would date the beginning of his *medical* studies at around 1589 at which time he may be supposed to have been 20 years old. The "Dictionnaire," l. c., gives "vers 1575."

[6] Vignaux, l. c., p. vii: "Le plus ancient document qui le concerne est la mention sur un registre des Pénitents bleus de Toulouse, à la date du 25 mars 1587, de 'Guillaume Dader, escolier, de Gascouigne.'"

[7] Enarrationes, p. 421-422.

[8] De pestis cognitione, p. 79: "... et in praefata Narbonensi peste maior aegrotantium pars cum immedicabili dysenteria interiit. His medebatur praeceptor meus Mercerius Cardinalis Joyosae archiatros" etc. Cf. Vignaux, l. c., p. viii.

[9] Cf. Vignaux, l. c., p. ix-x, and for the rest of the family, p. xvii, footnote.

[10] De pestis cognitione, p. 94-96.

Gimont certainly was his residence, for when he died on June 23rd 1638, his death was registered there as that of " Me. Guilhaume Ader, docteur en médecine et médecin de la ville de Gimont." [11]

In the framework of the old system of medicine, Ader reveals himself as a circumspect and shrewd practitioner. Although he himself believes in astrological predictions of epidemics,[12] he does not hesitate to make a rather hypocritical use of the horoscope for psychotherapeutic purposes. He had two cases of young men who had become mute and could not be brought to speak, but Ader effected a cure by first frightening and then impressing them. From their horoscopes he predicted their death. Then he gave them a remedy to drink which he commended as occult, and their speech was immediately restored to the satisfaction of all present.[13] His good common-sense is also revealed by the story of two students who, having studied too much and having acquired a melancholic temperament in Toulouse, a town which did not suit their constitution, had finally become mad and could scarcely be restrained even with fetters. The most experienced physicians of the town being unable to cure them, Ader was called in and expressed the opinion that the two young men needed a change of air and manner of life. On his advice they were sent home, where they recovered completely.[14]

Gimont was the centre of Ader's poetic activities. The preface to his " Catounet Gascoun " is dated from Gimont, October 1st, 1607, and at the end of the same poem he added a French sonnet and a Latin distich " aux galans hommes et poètes Gimontois," where he tells this circle of provincial poets:

[11] Cf. Vignaux, l. c., p. xvi and xlviii. Vignaux, p. xii f., thinks that only from 1625 on can Ader's residence in Gimont be accepted as certain, whereas Jeanroy, ibid., p. xxviii, footnote, believes that he moved there from Toulouse between June 11th and October 1st 1607.

[12] Cf. De pestis cognitione, pp. 16-21 and 91.

[13] Enarrationes, p. 412-413: ". . . ut duos praestantes et doctos iuvenes, quos nos vidimus a multis diebus factos mutos, nec velle loqui, etiam si diversorum Medicorum praescripto, frictionibus asperis, dolorificis ligaturis, scarificationibus profundissimis circa scapulas urgerentur. Quos simulata ab eorum horoscopo a nobis ante eos depicto praedictione mortis, et dato ac propinato remedio, quod ut occultum praedicabamus, magno adstantium applausu extemplo fecimus loquentes. Unus eorum erat Lumberiis, in charissima patria mea, alter florentissima in urbe Cadurcorum."

[14] Ibid., p. 234-235.

" Vous aymez tendrement vostre Muse Gascone,
Qui docte, riche, et belle en vostre vers resonne,
Et se faict escouter au langage voisin."

He must have been well esteemed by his literary friends who wrote flattering poems in honour of his " Gentilome Gascoun," but his own ambitions had a higher aim, for in the same sonnet he adds:

" Je l'ayme, mais non pas pour allumer des flammes,
Mais pour remedier aux erreurs de nos ames
Et me dire en effect, d'ame et corps Médecin." [15]

His desire of combining his medical and poetic interests found a further expression in a French poem on the " Bezoar "-stone, which he published before 1628 but which has been lost. From the remarks in his " De pestis cognitione " it can, however, be inferred that he distinguished three kinds of bezoar-stone: first, the " lacrimula cervi," a concretion in the corner of the eye of the deer, secondly, the stone in the stomach of the Persian he-goat to which he attributed great powers for the expulsion of poisons and the cure of pestilential fevers, and finally, the pseudo-bezoar which had no powers whatever, although it was sold at a high price.[16]

The centre of his activities as a medical teacher and lecturer was Toulouse. Chiefly owing to two men, Augier Ferrier, the favorite of Catherine of Medici, who was professor at Toulouse from 1581 till his death in 1588, and the even more important philosopher and physician Francisco Sanchez who occupied one of the medical chairs from 1611 till 1623, the medical faculty of Toulouse had at that time emerged from its rather obscure existence.[17] Ader did not become one of the " doctores regentes," i. e. full professors;

[15] Poésies de Guillaume Ader, l. c., p. 220.

[16] De pestis cognitione, p. 52-53: " De Bezoar editum est a nobis poëma Gallicum. Primum bezoar est cervi lacrimula, ad maiorem oculi canthum indurata. Aliud bezoar est lapis in ventriculo hirci Persici, Pazan dicti repertus. Horum autem magna vis est ad expellenda cuiuslibet generis venena, curandasque febres pestilentes. Tertium falsum est ex locis Persae vicinis, montibusque Comorin, et aliis adductum, quod neque similes habet vires, neque gry quidem adversus venenatos et pestilentes morbus virium habet: ut multis experimentis visum a nobis est, Hoc tamen pseudo-bezoar nobis est vulgare, magnique pretii, licet nullius effectus." Cf. also ibid., p. 76.

[17] Cf. J. Barbot, Les chroniques de la Faculté de Médecine de Toulouse, T. I, Toulouse, 1905, pp. 82 ff. and pp. 112 ff.

he probably belonged to the lecturers who were chosen by the doctors forming the faculty.[18] It has even been assumed that he gave instruction about the plague at the hospital of St. Jacob,[19] an assumption which is based on a book which appeared under the title: Guillelmi Ader Medici Tolosatis, De pestis cognitione, praevisione, et remediis. Praelectiones in libellulum redactae. Ad augustissimum nobilissimumque Senatum Tolosanum. Tolosae Typis Raim. Colomerii, Regis et Academiae Typo graphi. 1628. But while it is possible that at least in 1607 he held some kind of medical post in Toulouse,[20] the work on the plague seems much more like an outcome of a lecture course on surgery, in which he followed the famous medieval surgeon Guy de Chauliac.[21] Ader's interest in surgery is furthermore confirmed by a little book of 35 pages, "De la méthode de consulter les maladies chirurgicales," which was published in Paris in 1628 and the only copy of which is preserved at the Bibliothèque Sainte-Geneviève in Paris.[22]

But by far the most voluminous and most interesting of his medical publications is his contribution to biblical medicine, his "Enarrationes de aegrotis et morbis in Evangelio. Opus in miraculorum Christi Domini amplitudinem Ecclesiae Christianae elimatum." The book was first published in Toulouse in 1620 in two separate editions, one "typis Ramundi Colomerii" (12 l., 450 pp., 3 l.) showing the

[18] Cf. Vignaux, p. xi and Barbot, l. c., p. 170.

[19] Barbot, l. c., p. 412.

[20] De pestis cognitione, p. 92: ". . . paucique sunt qui laborent in urbe, et xenodochio Divi Jacobi huius urbis Tolosae, quorum saluti praesum, dum hodierna die undecima Junii, anno septimo supra mille sexcentesimum haec scribo."—From this passage it has been concluded that he was physician at the hospital (cf. Vignaux, l. c., p. ix-x); it may, however, simply mean that he had patients in the city and its hospital.

[21] De pestis cognitione: "Ad auditores, Praefatio. Ad morbos pectoris externos, Dum hodierna exercitatione cum Guidone Cauliaco divertimus (Auditores Philiatri) movit me tanti, tamque fidelis, et experti Medici historia de peste universali, totoque mundo funesto."

[22] Cf. Vignaux, l. c., p. xxxvi. Couture who rediscovered this book gives the following description of the work which I have not seen: "*De la méthode de consulter les maladies chirurgicales. Divisée en quatre parties, savoir: la cognoissance du sujet que l'on traicte, la cognoissance de la maladie, la prognostique et la cure d'icelle. Avec un sommaire de toutes sortes de consultes, et exemples familiers sur la fin. A Paris, chez Cardin Besongne, au second pilier de la grande salle du Palais.* 1628, 35 pages in-12," etc. (Bulletin du Bouquiniste, T. VII, 1860, p. 295).

arms of Daffis, bishop of Lombez, on the title-page;[23] the other, "Apud Dominicum, et Petrum Bosc" (12 l., 458 pp., 3 l.) showing a landscape with a shepherd and two sheep on the title-page (cf. fig. 1).[24] The latter edition appeared also under the date of 1621. The number of later editions has not yet been established.[25]

The reader is informed of the aims of the work in the dedicatory letter to the bishop of Lombez, Bernard Daffis, and in a preface to the reader. The book is written to the glory of Christ and his church. It has been known that Christ cured a great number of sick people but nobody has shown so far that these people suffered from diseases which were absolutely incurable by the medical art. In demonstrating this fact, Ader seeks to prove the true omnipotence of Christ,[26] and this demonstration forms the first part of the book. There may, however, be readers who are not acquainted with medicine, and for their benefit the principles of the art must be outlined and the diseases, as diagnosed in the first part, expounded from a medical point of view. This forms the subject of the second and third parts of the work.[27]

Whoever has tried to diagnose exactly the diseases described in the Bible knows how difficult a task this is, and the subject has remained controversial to the present day.[28] But although fully conscious of the difficulties involved, Ader trusts his thirty years of medical experience and he succeeds not only in establishing a diagnosis but even in proving in every case to his own satisfaction that it was incurable "lege artis." He finds then that hopeless cases of the following diseases were cured:

[23] Cf. Vignaux, l. c., p. xxxvi.

[24] I have used this edition.

[25] The "Dictionnaire" l. c. mentions one "Londres, 1660, in-8o."

[26] "Antiquum etenim et nihil antiquius aegrotos magno numero sanasse Dominum: Eos autem arte Medica incurabiles omnino fuisse, adhuc a nemine demonstratum. Miraculum quidem et ubique magnum vel in leviter aegroto dicere, Surge, tolle grabatum et ambula. Admirabilius tamen in desperato, et ab omni spe remedii retro collapso. Christo ergo Omnipotenti, cuius solius est vere θαυματουργειν elimatum est opusculum, quod curatos ab eo incurabiles ab arte clare demonstrat."

[27] Preface. "Ne autem forte lectores quibus Apollo noster ignotus est, aut remoretur morbi ignoratio, aut implicet rerum medicarum inexercitata cognitio: utile visum est et expetitum a multis, Medicae artis principia in secunda operis nostri parte proponere. Eosque tandem in tertia enarrare morbos, quibus praehensos iam dictos reperiemus aegrotos."

[28] Cf., e. g., Friedrich Fenner, Die Krankheit im Neuen Testament. Leipzig, 1930.

# GVILLELMI ADER
## MEDICI,

## ENARRATIONES,
DE ÆGROTIS, ET MORBIS
in Euangelio.

*OPVS*
IN MIRACVLORVM CHRISTI
Domini amplitudinem Eccleſiæ Chriſtianæ elimatum.

*Operis partes indicabit ſequens pagella.*

*TOLOSÆ,*
Apud Dominicum, & Petrum Boſc.
M. DC. XX.

Fig. 1.

Leprosy:—S. Matth. 8, 2 — S. Mark 1, 40 — S. Luke 5, 12.
Paralysis:—1st case: S. Matth. 8, 5 — S. Luke 7, 2;
2nd case: S. Matth. 9, 2 — S. Mark 2, 3;
3rd case: S. John 5, 5.
Chronic muscular contraction (" convulsio "):—S. Luke 13, 11.
Epilepsy:—S. Matth. 17, 15 — S. Mark 9, 17 — S. Luke 9, 38.
Lycanthropy:—S. Matth. 8, 28 — S. Luke 8, 27 — S. Mark 5, 2.
Blindness:—1st case: S. Matth. 9, 27;
2nd case: S. Matth. 20, 29 — S. Mark, 10, 46 — S. Luke 18, 35.
Muteness:—S. Matth. 9, 32.
Muteness combined with deafness:—S. Mark 7, 32.
Fever:—1st case: S. Matth. 8, 14 — S. Mark 1, 30 — S. Luke 4, 38;
2nd case: S. John 4, 46.
Dropsy:—S. Luke 14, 2.
Atrophy of the arm combined with muscular contraction: S. Matth. 12, 10 — S. Luke 6, 6 — S. Mark 3, 1.
Uterine bleeding:—S. Matth. 9, 20 — S. Mark 5, 25 — S. Luke 8, 43.

To illustrate the methods which Ader applies in his interpretation, it will be best to analyse one of the cases in more detail, e. g., that of supposed lycanthropy.[29] He inquires first into the locality where the miracle of the expulsion of the demons took place, and finds that this locality was especially apt to cause the accumulation of melancholic humors. That melancholy was involved seems to be clear from the words of S. Matth. 8, 28: ". . . coming out of the tombs, exceeding fierce, so that no man might pass by that way." And the description in S. Luke 8, 27: " a certain man, which had devils long time, and ware no clothes, neither abode in any house, but in the tombs," and 8, 29: ". . . and he was kept bound with chains and in fetters; and he brake the bands, and was driven of the devil into the wilderness," Ader compares with the symptoms of lycanthropy as given by Paulus of Aegina, book 3, chap. 16, and finds an almost complete congruity. But there is further confirmation. From the itinerary of Christ, Ader concludes that the cure

[29] Cf. Enarrationes, pp. 31-41.

took place in the last part of winter, around February, and indeed the learned physicians Mercurialis and Massaria have noted that lycanthropy occurs under the influence of this season.[80] Lycanthropy is a form of mania which again is an advanced stage of melancholy, and Mercurialis numbers a disgraceful and shameful life among the causes of the lycanthropic form of melancholy. Now the patient mentioned by S. Mark and S. Luke was famous and well-known in the country of the Gadarenes, a garden of riches and pleasantness; he must, therefore, have been rich, or at least have associated with rich people. But "ubi divitiae, ibi vitia: ubi affluxus, ibi luxus: ubi Plutus, ibi Venus."[81] And such a severe illness was cured by the simple command of Christ: "Come out of the man, thou unclean spirit." This, as Ader points out, was indeed a great miracle. But even if the affliction had not been caused by demons but were a simple case of melancholy, as some impious Epicureans might maintain,[82] the miracle would not have been less impressive. For it is obvious on the authority of Hippocrates, that such a derangement of the melancholic humours could not be cured by the physicians.

Ader's interpretation clearly labours under a difficulty. According to the biblical text these patients as well as many others were possessed by demons. Origines had already emphasised that they were cases of demoniac possession and nothing else.[83] Against Origines Ader contends that a disease must have been involved[84] and this is an obvious condition for his whole interpretation. On the other hand, he does not deny the existence and potency of demons but firmly believes in them, and in the third part of the work he tries to make his attitude clear. Demons, he thinks, may enter the body and may act on the humours, and may thus be a cause of the development of any disease. It is therefore extremely difficult to ascertain

[80] Ibid., p. 37: "Quo tempore notant doctissimi Medici Mercurialis et Massaria a propria quadam huius temporis constitutione, Lycanthropiam contingere."

[81] Ibid., p. 38.

[82] Ibid., p. 39: "Sed (date hoc Christiano Medico in nefarios illos et impios Naturae aut Fati credulos quos tenet Epicurus.) Sint propositi Geraseni absque Daemone pure melancholici," etc.

[83] For Origines' attitude cf. F. J. Dölger, Der Einfluss des Origines auf die Beurteilung der Epilepsie und Mondsucht im christlichen Altertum (Antike und Christentum, Band IV, Münster i. W. 1934, pp. 95 ff.).

[84] Enarrationes, p. 32: "non erit absonum, aut a divinis literis, et Evangelistarum mente alienum: si eos etiam a morbifica causa laborasse morbo intelligamus."

whether a disease is purely natural, or whether supernatural powers are involved in it. In a chapter which is very interesting from a cultural point of view, he tries to distinguish between natural epilepsy, ecstasy due to divine inspiration, and ecstatic states due to diabolic possession;[85] for he knows that all three of these conditions may show very similar symptoms.

It is at this point that we may draw a comparison between Ader's work and the "Medica sacra" of Richard Mead. The purpose of their works was ultimately the same, since both tried to demonstrate the power of Christ.[86] The differences seem to lie in two directions: whereas Ader admits the rôle played by demons, it is one of Mead's chief objectives to refute such superstitious beliefs; and where Mead is satisfied to point out the kind of disease, Ader has to enter upon very abstruse arguments in order to prove the absolute incurability of the case.

Strictly speaking it is only the first part of Ader's book which deals with the diseases of the gospels. But the second and third parts are interesting in so far as they contain a short and rather straightforward account of medicine as given by a French provincial physician to an audience of non-medical men in the early 17th century. As could be expected from the first part, where quotations from church-fathers and later theologians revealed a broad learning, Ader is well versed in the medical literature of his days. In his account of the anatomy of the human body he follows the order of the medieval dissections, as he himself may have conducted them, and for a fuller account he refers the reader to the works of Galen or the moderns, Vesalius, Sylvius, Laurentius and others.[87] He describes the three ossicles of the ear and notes that they had been unknown to the ancients.[88] He is doubtful about the functions of the so-called rete

[85] Ibid., p. 359: "De differentia Epilepsiae ab ecstasi divina, et ea quae est a daemone, a furore, stupore, etc."

[86] This has been noted long ago. Cf., e.g., "Biografia Universale," Vol. I, Venezia, 1822, p. 227.

[87] Enarrationes, p. 127 f.: "Et ad sublevandam in tam longo opere memoriam, solas corporis partes et earum usum brevi designemus, eo ordine, quo eas in publicis sectionibus nos saepe demonstramus, pleniorem earum enarrationem ad opus Anatomicum Galeni, aut recentiorum, Vessalii, Sylvii, Laurentii, vel alterius qui erit ex voto et ad manum, referentes."

[88] Ibid., p. 164: "Sed dictu mirum, sunt in hac camera ossicula tria, veteribus minime nota. . . . Imposita est illis nomenclatura a forma Incus, Stapes, et Malleolus."

mirabile at the base of the brain.[39] The septum of the heart, however, still contains pores to let the blood pass from the right to the left ventricle,[40] and for the traditional seven pairs of cerebral nerves he quotes the following distich:

> Optica prima oculos, movet altera, tertia gustat.
> Quartaque, quinta audit, sexta vaga, septima linguae est.[41]

One of his main sixteenth century authorities is Fernel [42] whom, however, he does not follow slavishly; and amongst the others he quotes Fracastoro, Falloppia, Riolan, Holerius, Duretus and Paré. But the chief and undoubted authorities are still Galen and Hippocrates and it must be admitted that he makes good use of his thorough knowledge of the ancients. Thus, for instance, he mentions percussion of the abdomen as a differential sign between ascites and tympanitis,[43] a procedure which had been described by Galen and Aretaeus.[44] The influence of the medical work of the Renaissance, on the other hand, is chiefly noticeable in his language. He writes the baroque Latin style which is intermingled with Greek terms and whole sentences, the Arabic terms having disappeared almost entirely.

The "Enarrationes" are the publication of a series of lectures which Ader began in 1617 with a speech, printed at the end of the book, on the subject: "Christ the Lord is the true physician of all diseases. Against those who promise to cure all diseases by remedies unscientifically derived from the art, or invented by the fraud of demons," [45] i. e. against empirics and Paracelsists. Ader considers Hippocrates the true founder of medicine who had opposed the frauds of the heathen priests, and he calls upon his hearers to follow

[39] Ibid., p. 159.
[40] Ibid., p. 148.
[41] Ibid., p. 160-161.
[42] Ibid., p. 229: "Nullus est, meo iudicio, in cognitione singulorum morborum Fernelio nostro praeferendus" etc.
[43] Ibid., p. 435: "Percussi autem tympani in modum respondet sonus ad manus impulsum in Tympanite."
[44] Cf. Galen, ed. Kuehn, vol. VIII, 951; Aretaeus, On the causes and symptoms of chronic diseases, book 2, chap. I.
[45] Enarrationes, p. 446: "Guillelmi Ader Medici. Oratio. Habita Tolosae Anno 1617. antequam praefatas Enarrationes publice diceret. Christum Dominum morborum omnium verum esse Medicum. Adversus eos, qui remediis ab arte petitis inscienter, aut Daemonum fraude inventis, morbos omnes curare pollicentur."

Hippocrates and not to listen to Paracelsus, whom he quotes as having said: "We must learn all arts, must try everything; the lesser has to learn from the greater. The devil is more learned than we are: if we know his art, we do not offend God. Let nobody care whence the good things come to us, whether they proceed from good or from bad spirits." [46] Again and again he declaims against treatment by old women and empirics,[47] and the use of chemical drugs, which "diabolic impostures" he never employs himself.[48]

A curious rumor had it that the "Enarrationes" had only been written as a recantation of an earlier work in which Ader had contended that all the diseases mentioned in the gospels could have been cured by perfectly natural means, without the help of divine miracles.[49] There is no evidence for such an accusation which appears highly improbable. For the belief that such desperate cases as described in the gospel could not be cured by men but needed divine miracles is fundamental for Ader's fight against Paracelsus whom he accuses of having promised the cure of all diseases, even demoniac possession and leprosy, a contention which Ader considers the idea of a madman.[50]

[46] Ibid., p. 450: "Audite putidissimum doctorem impudentissimo suo in libro, de origine morborum invisibilium. Discendae sunt nobis omnes artes (ait blatterator) omnia tentanda, minor discat a maiore, Diabolus est nobis doctior: si illius artem callemus Deum non offendimus. Nemini curae sit unde nobis bona adveniant, sive a bonis sive a malis spiritibus procedant."

[47] Ibid., p. 429: "Mulierculis et rerum medicarum imperitis ne fidamus, temerarios ciniflones, agirtas, et empiricos fallaces exsibilemus."—In the dedication of his De pestis cognitione he beseeches the senate to keep the "impostores, fumivendulos Chimistas, futiles seplasiarios et pseudospagiricos" away from the city.

[48] De pestis cognitione, p. 48: "Scio quosdam describere empirica, et spagiricis usitata remedia, pillulas Mercuriales, Antimonii flores, aliaque eiusdem farinae. Ego nunquam utar his diabolicis imposturis" (i. e., as cathartics).

[49] This story is told e. g. at length in the "Dizionario Poligrafico" of Gianfrancesco Pivati, T. I, Venezia, 1761, p. 277, who refers to "Vigneul-Marville, Miscellanee di Storia e di Letteratura tomo 3. pag. 152. e segg." Couture, l. c. p. 294, expressing his own disbelief in the story, refers to the French edition of 1701. I was, however, not able to find any trace of it in the 4th French edition of Vigneul-Marville's Mélanges d'histoire et de litterature, Paris, 1725.

[50] Enarrationes, pp. 451-452: "Insanit certe homo hic, irruit in se ipse, et segetem incidit suae famae, dum obsessos a Daemone restituere, Leprosos mundare si non exuere pelle, si diis placet policetur. Paracelse celse nimis, cave ne omen in nomine sit ominosum."

# CONTRIBUTIONS TO THE MICROSCOPIC ANATOMY OF THE PANCREAS *

BY

PAUL LANGERHANS

[Berlin, 1869]

Reprint of the German original with an English Translation and an Introductory Essay by

H. MORRISON, M.D.

"Truth grows like a living organism and its gradual evolution may be traced from the tiny germ to the mature product."

OSLER, "Harvey and his Discovery."

While gathering data, in 1931, on outstanding contributions in medicine by men still in their undergraduate years, I was shown the Boston Medical Library copy of the inaugural thesis written by Paul Langerhans. This dissertation, published in Berlin in 1869, gave the first description of the specialized pancreatic cells now known as the islands of Langerhans. It was a noteworthy contribution and is the more impressive in that Langerhans carried out this research while he was still a medical student. He began this investigation in the summer of 1867 in Virchow's laboratory in the Berlin Pathological Institute, and embodied its results in the inaugural dissertation for his doctorate in medicine two years later.

Before the publication of this thesis the pancreas was classified anatomically as a salivary gland, as indicated by the terms "Bauchspeicheldrüse" and "glande salivaire abdominale." Although physiologists, especially Claude Bernard, had already demonstrated (1848 to 1856) that its secretion played an important role in the digestion of carbohydrates proteins and fats, still no one before Langerhans had observed any glandular elements in it other than

* From the Department of Medicine, Tufts Medical School. Read before the Boston Medical History Club.

the excretory canals and the secreting cavities of a simple salivary gland. In his opening paragraphs Langerhans stresses that he could find nothing in the textbooks about the structure of the pancreas other than that it is a racemose gland. "There is indeed," he says, "hardly another organ in which there is such glaring contrast between the brilliant results of physiological research and the complete darkness in the realm of anatomic knowledge." Determination to meet this challenge resulted in his modest little work of thirty-one pages entitled "Contributions to the Microscopic Anatomy of the Pancreas" which has been acknowledged the first careful description of the histology of this organ.

His technique was simple. He worked almost exclusively with the pancreas of rabbits; its thin laminated structure made it most suitable for microscopic observation, and control studies had convinced him that in its essential features it did not differ from that of other mammals. Injection of the pancreatic duct with a colored fluid, chiefly Berlin blue mixed with glycerine, to bring out the duct system, was a procedure original with him. He studied the gland both in the fresh state and after fixation and maceration for two or three days in Müller's fluid. This preparation allowed fragmentation of the tissues into tiny particles for microscopic study without destroying the cellular structure.

In fresh specimens taken from the pancreas of rabbits just killed he studied especially the duct system with its rich ramification resembling a defoliated tree; because it appeared built up of numerous fine granules he called it a "Körnchenbaum." The smallest ducts were continuous with the lumen of the acini, and his injection experiments demonstrated a still further extension of the excretory system into the spaces between the secreting cells which make up the acini. Closer examination taught him that the above-mentioned granules belonged to these acinar cells and that they were located in the inner apical portion of these cells, adjacent to the lumen of the acinus. Now known as zymogen granules they were first described by Claude Bernard and later shown by Heidenhain to be the true pancreatic enzymes; but Langerhans considered them fat because they turned black with osmic acid, and dissolved with potash, ether, or chloroform.

By studying fragments of the gland after maceration he was able to differentiate the miscellaneous cells—nine different types—to be found in the pancreas: the peritoneal and duct epithelial cells, the nerve, connective tissue, vascular and blood cells, the acinar cells mentioned above, and two types not hitherto observed in any tissue. The last two he described in some detail. First to attract his attention were the small spindleshaped cells (#8) seen almost within every acinus in contact with the secreting cells, one, two, or more cells in the center. He called them centro-acinar cells. The close resemblance between them and the epithelium of the fine terminal ducts, and the continuity of the two, made him feel that there was functional relationship between them,—that possibly the centro-acinar cells were the termination or rather the beginnings of the excretory ducts.

Even more interesting to him and more puzzling as to their nature were the groups of cells scattered through the parenchyma (#9) which he designated as " Häuflein." To quote him: " I mentioned above when describing the varied structure which the pancreas shows, when teased apart after being kept in Müller's fluid, a cell form not yet closely described. This cell is a small irregularly polygonal structure. Its cytoplasm is brilliant and free of any granules, its nucleus distinct, round and of moderate size. Its diameter is 0.0096-0.012 mm. while that of its nucleus 0.0075-0.008 mm. These cells lie together, generally in considerable numbers, diffusely scattered in the parenchyma of the gland. If a pancreas which had been kept in Müller's fluid two or three days is examined under low power there are seen scattered through the gland many intensely yellow specks. Under higher power these specks are seen to consist entirely of our cells. They are gathered in rounded masses, 0.12-0.24 mm. in diameter, distributed at regular intervals in the parenchyma and can be easily seen in fragmented preparations of the fresh gland or in that treated for a short time in iodized serum." He could offer no explanation as to the nature of these cells. Neither could he draw any conclusions from his observations on the nerves or lymphatics of the pancreas, nor from his attempts to observe the phenomena of secretion of the gland in living animals.

Langerhans was not satisfied with the results of his investigation, and he apoligizes for its scanty contents. " With regret I must begin

my communication with the declaration that I cannot in any way put forth the conclusive results of a completed investigation. I can describe at most a few isolated observations which suggest a much more complicated structure of the pancreas than hitherto accepted. The purpose of these lines can therefore at best be to help draw greater attention to the pancreas than has hitherto been given by anatomists."

He wrote this in 1869 but recognition of the nature of his cells came slowly. Other observers, some of them unaware of his work, found them in the pancreas of all the vertebrates, each naming and explaining them differently. Not till 1893, five years after his death and a quarter of a century after the publication of his thesis, were the cells which he had first described associated with his name. This was done by Laguesse, an eminent French histologist, whose interest was drawn to these cell-groups when he found them in abundant numbers in the human pancreas. He identified them with those described by Langerhans in 1869 and named them " îlots de Langerhans." " Langerhans le premier, en 1869, a signalé dans le pancreas adulte de petits amas, ou groupes de cellules spéciales, disséminés de place en place entre les acini, et à signification inconnue. . . . Dans le pancreas d'un homme adulte (supplicié) je retrouve ces îlots très nombreux et volumineux (je les designerai provisoirement sous le nom d'îlots de Langerhans)." (Compt. rend. Soc. Biologie 1893, XIV, 819)

To Laguesse is also due the credit for first suggesting that these islands were the seat of an internal secretion. His hypothesis was based on the work of several investigators. Among them, Kühne and Lea in 1882 demonstrated in these cell-groups a very rich glomerular blood supply with an intimate relation between the cells and the capillaries and the nerves. Again, Dogiel in 1893 showed entire absence of any connection between these cells and the duct system of the gland. And, furthermore, von Mering and Minkowski made it clear that the pancreas had an internal as well as an external secretion. The brilliant research in this field during the next quarter century notably that of Schulze and Ssobolew on the ligation of the pancreatic duct, of Opie and Ssobolew on the pathology of the islands of Langerhans in diabetes, and that of Banting and Best,

finally established the true role of the groups of cells which Langerhans had first described. Thus his hope was realized. His own study of the pancreas was in itself a modest contribution, but because it broke ground for the brilliant work that followed it gained him a place in the history of medicine.

Langerhans was immortalized by the gracious act of Laguesse who associated his name with the internal secretory apparatus of the pancreas. Medical biographers, however, have given little attention to him, very likely because his creative energy was broken down by illness which cut short a promising career. Very few data, therefore, are available about him, and these only in his few biographical lines in his inaugural dissertation, in the few obituary notices, and from his widow and a brother still living in Germany. The accompanying photographs were obtained through the efforts of a young friend, L. S. Chase, a medical student in Berlin and through the courtesy of the "Institut für Geschichte der Medizin und der Naturwissenschaften" in Berlin.

Paul Langerhans was born in Berlin July 25, 1847, of Protestant parentage. It is worth noting that he was one of a family of physicians. The father, Doctor Paul Langerhans was interested also in municipal politics and was an "Ehrenbürger." The mother, née Keibel, was a cousin of Franz Keibel, the eminent histologist. Of two younger brothers (by another mother) Robert (1859-1904) was long assistant to Virchow and rose to a professorship in pathology, and Richard still living has long been a practitioner in Berlin and has the honorary title "Sanitätsrat."

Paul received his early education in the "Gymnasium zum Grauen Kloster" graduating at sixteen. In 1865-1866 he was a student in Jena; he then continued his studies with the Medical Faculty in Berlin through 1869. In Jena Ernst Haeckel was "his adored teacher"; in Berlin he was influenced particularly by Julius Cohnheim and Rudolf Virchow, and with the latter he developed a close friendship.

His aptitude for investigation came to the fore in his student days, and his first publication appeared in Virchow's Archiv in 1868, a study of the nerves in the human skin, employing Cohnheim's gold chloride method. "Meine Untersuchungen habe ich im patholo-

gischen Institut zu Berlin angestellt und mich der bereitwilligsten und freundlichsten Unterstützung von Seiten des Herrn Pro. Virchow sowohl als des Herrn Dr. Cohnheim zu erfreuen gehabt." He described in this work, among others, two structures which bear his name: Langerhans's granular layer, a layer of epidermal cells above the rete mucosum, and Langerhans's stellate corpuscles, terminations of nerve fibers in the rete mucosum of the epidermis. The following year he published another research, stimulated by the offer of a prize by the Medical Faculty, on the state of the tactile corpuscles in diseases of the central nervous system and of the skin. Then came his work on the pancreas. After receiving his doctorate he continued in Virchow's laboratory in preparation for an academic career, and at that time in collaboration with F. A. Hoffman he studied the disposition of cinnabar, red oxide of mercury, injected intravenously in rabbits and guinea-pigs, showing that eventually this substance was taken up by the fixed connective tissue cells (reticulo-endothelial system).

His next publication in the Archiv, a letter to Virchow dated May 13, 1870, written in Jerusalem, shows him traveling through Northern Africa and Asia Minor. He bewails the backward state of medicine there. "Sectionen werden überhaupt nicht gemacht, und an ein Studium von Entozoen, wie ich es Deinem Wunsche entsprechend, Herrn Dr. S. vorgeschlagen, demnach gar nicht zu denken." Still he sends notes on leprosy, skull measurements on Bedouins and Fellahin, and other anthropological data (Virchow's influence is very apparent).

When he returned to Germany at the end of 1870, the Franco-Prussian War was well along, and anxious for service he first worked in a hospital in Berlin and then did ambulance work at the front. The war over, he worked for a short while with Crédé in Leipzig, and in 1871 became prosector in pathology in Freiburg im Breisgau (equivalent to assistant-professorship). His "Habilitationschrift," a thesis required before one serves as lecturer, was on the structure of the sympathetic ganglion cells. At Freiburg he remained four years, engaged in teaching and research, publishing papers, all in Virchow's Archiv, on the histology of the heart, of the accessory glands of the genital organs,—the prostate, vas deferens, seminal

vesicles, the Cowper and Bartholini glands,—on the architecture of the spongiosa of the spine and the extremities.

He was subsequently elevated to a full professorship, but he had to give up because of illness,—pulmonary tuberculosis of some standing. Attempts at cure in Germany and Italy failed and he finally settled in Madeira. There he at first devoted himself to zoological studies incidental to deep sea fishing. His health improved steadily, and as more and more Germans in Madeira began to consult him he finally settled down into active practice. He never gave up, however, his interest in research, and between 1881 and 1885 there are clinical studies by him in Virchow's Archiv on the treatment of leprosy, on the etiology of phthisis, and on the spread of tubercle bacilli in the body. He also compiled a "Handbook on Madeira" dealing with the climatic and curative possibilities in that part of Spain.

In 1885, in Madeira, he married Margarethe Ebart (née Jordan) and there followed, as she herself puts it, "three indescribably happy years." One daughter was born to them. In 1888 a severe infection brought on kidney disease which caused his death July 20, at the age of forty-one. He was buried in Madeira "mourned deeply by his family, his patients, and his many friends." Those who knew him spoke of him as a typical child of Berlin, of happy and genial disposition, with keen desire to advance knowledge; and their feeling was that had he not been restricted by illness he might have risen to foremost rank in his chosen field.

It is close to half a century since Paul Langerhans died. He is remembered because it was his privilege to see and first to describe that tiny structure in the pancreas which became the germinal center of a brilliant chapter in medical progress, and I offer a translation of his thesis as a tribute to his memory.

## List of Publications by Paul Langerhans

1868

Ueber die Nerven der Menschlichen Haut. Arch. f. Path. Anat. u. Physiol. u. f. Klin. Med. Vol. 44, p. 325.

1869

Zur pathologischen Anatomie der Tastkörper. Vol. 45, p. 413.

Beiträge zur mikroskopischen Anatomie der Bauchspeicheldrüse. Inaugural-Dissertation. Berlin.

Ueber den Verbleib des in der Circulation eingeführten Zinnobers. Vol. 48, p. 303 (With F. A. Hoffmann).

1870

Lepra und Leproserien in Jerusalem (May 13, 1870). Vol. 50, p. 453.

1871

Ein Beitrag zur Anatomie der sympathischen Ganglienzellen. Freiburg im Br. F. 16 pp.

1873

"Untersuchungen über Petromyzon Planeri." Freiburg i. Br., 8°, 10 tables.

Zur Histologie des Herzens. Vol. 58, p. 65.

Ueber mehrschichtige Epithelien. Vol. 58, p. 83.

1874

Ueber die accessorischen Drüsen der Geschlechtsorgane, Vol. 61, p. 208.

Beiträge zur Architectur des Spongiosa. Vol. 61.

1881

Zur Behandlung der Lepra. Vol. 85, p. 567.

1884

Zur Aetiologie der Phthise. Vol. 97, p. 289.

1885

Handbuch für Madeira. Berlin, 12°, pp. 206.

1888

Ueber die Verbreitung der Tuberkelbacillen in Körper. Vol. 112, p. 16.

All journal references are for the Arch. f. Path. Anat. u. Physiol, u. f. Klin. Med.

Sitting: Dr. PAUL LANGERHANS, senior
Standing: Middle—PAUL LANGERHANS
Left—Sanitats-Rat Dr. RICHARD LANGERHANS
Right—Professor Dr. ROBERT LANGERHANS
September 10, 1884

PAUL LANGERHANS 1885

PAUL LANGERHANS 1873

UNIV. OF MICH.

Beiträge

# zur mikroskopischen Anatomie der Bauchspeicheldrüse.

## INAUGURAL-DISSERTATION,

ZUR

ERLANGUNG DER DOCTORWÜRDE

IN DER

## MEDICIN UND CHIRURGIE

VORGELEGT DER

MEDICINISCHEN FACULTÄT

DER FRIEDRICH-WILHELMS-UNIVERSITÄT

ZU BERLIN

UND ÖFFENTLICH ZU VERTHEIDIGEN

am 18. Februar 1869

VON

**Paul Langerhans**

aus Berlin.

**OPPONENTEN:**

G. Loeillot de Mars, Dd. med.
O. Soltmann, Dd. med.
Paul Ruge, Stud. med.

BERLIN.

BUCHDRUCKEREI VON GUSTAV LANGE.

Fig. 1.

# BEITRÄGE
# ZUR MIKROSKOPISCHEN ANATOMIE DER BAUCHSPEICHELDRÜSE.

INAUGURAL-DISSERTATION,

ZUR

ERLANGUNG DER DOCTORWÜRDE

IN DER

MEDICIN UND CHIRURGIE

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AM 18. FEBRUAR 1869

VON

PAUL LANGERHANS

AUS BERLIN.

Im Sommer 1867 begann ich im Berliner pathologischen Institute, das mir durch die Güte des Herrn Professor Virchow geöffnet war, eine Reihe von Untersuchungen über den feineren Bau der Bauchspeicheldrüse, und wurde dabei mit Rath und Material auf's Freundlichste von Herrn Dr. W. Kühne unterstützt, dem damaligen ersten Assistenten am pathologischen Institut, jetzigen Professor der Physiologie zu Amsterdam. Im Herbste desselben Jahres zwangen mich jedoch anderweitige Umstände, meinen Gegenstand einstweilen zu verlassen, und gestatteten mir erst im October 1868, ihn wieder aufzunehmen, ohne dass ich indess wesentlich weiter kam. Eine wiederholte Bestätigung des früher bereits Gesehenen war fast das einzige Resultat dieses neuen Versuches.

Der einzige Zweck dieser Entstehungsgeschichte meiner Arbeit ist Motivirung und Entschuldigung ihres geringen Gehaltes. Ich muss leider meine Mittheilungen mit der Erklärung eröffnen, dass ich in

keiner Weise im Stande bin, die abgeschlossenen Resultate einer erfolgreichen Untersuchung vorzulegen, sondern höchstens wenige vereinzelte Beobachtungen beizubringen vermag, welche einen ungleich complicirteren Bau des untersuchten Objectes ahnen lassen, als man bisher annahm. Der Zweck dieser Zeilen kann somit selbst im besten Falle nur der sein, der Bauchspeicheldrüse eine etwas grössere Aufmerksamkeit zuwenden zu helfen, als ihr bis jetzt von den Anatomen geschenkt wurde.

Es giebt in der That kaum ein zweites Organ, bei dem die glänzenden Resultate der physiologischen Forschung in einem so grellen Contrast stehen zu der vollkommenen Dunkelheit, welche auf dem Gebiete der anatomischen Kenntnisse herrscht. Fast ausschliesslich die Beziehungen der Drüse zum Bauchfell und die höhere oder tiefere Einmündung des oder der Ausfuhrgänge sind es, welche sich, namentlich auch vergleichend-anatomisch, einer etwas eingehenderen Berücksichtigung zu erfreuen hatten. Ueber die Structur der Drüse gelang es mir nicht etwas Anderes aufzufinden, als die Angabe der Handbücher, das Pankreas sei eine traubenförmige Drüse, welche meistentheils eine störende Menge Fett enthalte. In dem Mémoire sur le pancréas von Claude Bernard findet sich eine sehr wohlgelungene Abbildung eines Drüsenläppchens, ausserdem die Notiz, es seien auch viele Kerne im Pankreas vorhanden. Abgesehen davon kennt man den Verlauf der Blutgefässe sehr genau, und es ist auch in der That vollkommen unmöglich, einige Unzen einer gefärbten Flüssigkeit in die Aorta eines Thieres zu injiciren, ohne die zierlichen Gefässschlingen der Bauchspeicheldrüse aufs Schönste zur Anschauung zu bekommen. Eine Injection der Drüsengänge ist jedoch, soweit ich die betreffende Literatur übersehen kann, noch nicht gemacht worden. Diesen ziemlich unvollkommenen Notizen gegenüber scheint mir eine eingehendere Schilderung wohl gestattet, und ich bitte nur um Verzeihung, wenn etwa diese Zeilen einem erfahrenen Mikroskopiker in die Hände fallen sollten und er des Bekannten ein wenig zu viel, des Unbekannten viel zu wenig darin findet.

Ich untersuchte vor allem und fast ausschliesslich das Pankreas des Kaninchens; denn von all den Thieren, die gewöhnlich in den Laboratorien zu unserer Verfügung stehen, ist es dieses, dessen Bauchspeicheldrüse den zur Untersuchung günstigsten Bau besitzt.

Sie ist zum grossen Theil flächenartig zwischen den Blättern des Mesenteriums ausgebreitet und zwar in so dünnen Schichten, dass man mit der Scheere entnommene Theilchen ohne irgend eine weitere Präparation der mikroskopischen Betrachtung unterwerfen kann. Dies gilt in ähnlicher Weise, wenn auch für einen relativ wie namentlich absolut kleineren Theil des Organes für die Bauchspeicheldrüse des Triton, während Mensch und Meerschweinchen, Hund und Katze, Taube und Natter, ebenso wie Frosch und Huhn ganz compacte und demgemäss zu so directer Beobachtung ungeeignete Bauchspeicheldrüsen besitzen.

Betrachtet man nun ein noch lebenswarmes, dem eben getödteten Kaninchen entnommenes Stückchen Pankreas in einer möglichst indifferenten Flüssigkeit bei schwacher Vergrösserung unter dem Mikroskop, so gelingt es in den weitaus meisten Fällen nicht, eine Spur von Kernen zu entdecken. Man erblickt Nichts, als eine feine, den Aesten eines entblätterten Baumes nicht unähnliche Zeichnung, gebildet von feinen, meist leicht gelblich glänzenden Körnchen. Dieser Körnchenbaum verzweigt sich aufs Zierlichste und stellt in den, oft gefässe-umsäumten Endläppchen einen einfachen, im Centrum der Läppchen verlaufenden Strang dar. Betrachtet man diesen mit stärkeren Systemen, so gewahrt man leicht, dass er keineswegs ein compactes Gebilde ist, sondern im Gegentheil überall einen, allerdings meist sehr feinen centralen Hohlraum zeigt. Dieser feine weisse Hohlraum, allseitig von einer reichlichen Menge der kleinen Körnchen umgeben, hängt continuirlich mit den selbst ohne weitere technische Hülfe leicht wahrnehmbaren grösseren Ausführungsgängen der Drüse zusammen, und jede Injection beweist zweifellos, dass er in der That dem System der ausführenden Wege angehört. Neben dem gangumgebenen Körnchenbaum, zwischen ihm und der Membrana propria des Drüsenläppchens, erscheinen nun bald früher, bald später in einfacher Reihe neben einander die Kerne der Drüsenzellen als grosse helle Bläschen, die oft ein glänzendes Kernkörperchen enthalten und in nicht seltenen Fällen an ihrer der Peripherie des Läppchens zugewandten Seite von einer kleinen Haube dunkler Körnchen, selten mehr als zehn, bedeckt werden. Zerzupft man ein Stückchen der frischen Drüse, so kann man leicht feststellen, dass auch die gangumgebenen centralen Körnchen den Zellen der Drüse

selbst, den wahren Sekretionszellen, angehören. Sie stellen einen in der ganz frischen, rundlichen Zelle, ebenfalls runden, in der festgeronnen- polygonalen dagegen eckig gestalteten Haufen dar von annähernd derselben Grösse, wie der Kern, d. h. ungefähr 0,0064 Millimeter im Durchmesser, während die ganzen Zellen 0,016 bis 0,024 Millimeter lang sind. Man kann somit an den Sekretionzellen des Pankreas drei Zonen unterscheiden: die acino-centrale Zone des Körnchenhaufens, die Zone des Kernes, und endlich die periphere Zone, welche in den meisten Fällen am frischen Präparat vollkommen homogen und durchscheinend ist, nicht ganz selten jedoch die wenigen oben erwähnten Körnchen enthält und an Grösse etwas den beiden anderen Theilen der Zelle nachsteht. Der feinere Bau der pankreatischen Zellen ist also ein ganz characteristischer; er zeigt wesentliche Abweichungen von der Structur andrer secretorischer Elemente und ermöglicht eine exacte Unterscheidung unserer Zellen von anderen ähnlichen Gebilden, ein, so viel ich weiss, ziemlich allein stehendes Faktum. Es gilt dies nicht nur von dem Pankreas des Kaninchens, sondern in ganz gleicher Weise von allen oben erwähnten Thieren, also: Frosch, Triton, Taube, Huhn, Hund, Katze, Meerschweinchen und Mensch. Eine Ausnahme scheint nur allein die Natter zu machen; wenigstens fand ich bei dem einen Exemplar, das ich von dieser Art untersuchte, eine nicht unbedeutende Anzahl von Zellen, die ganz von den erwähnten Körnchen erfüllt waren und nichts von einer regelmässigen Anordnung derselben ahnen liessen. Die Körnchen der Secretionszellen sind zweifelsohne identisch mit dem in allen Handbüchern erwähnten Fett und scheinen auch wirklich nichts als Fett zu sein. Sie zeigen, wenn die frischen Zellen mechanisch zerstört worden sind, eine lebhafte Molekularbewegung, und geben bei Behandlung mit Ueberosmiumsäure die tiefschwarze Färbung des Fettes. Ausserdem lösen sie sich in Kalilauge von ziemlich starker Concentration, in Aether und Chloroform. Bei der Lösung in letzterem entstehen sofort in der Zelle körnige Niederschläge, während unsere Körnchen heller und heller werden, um schliesslich ganz zu verschwinden. Die Behandlung der Zellen mit Kalilauge dagegen bewirkt unter ruckweisem Aufquellen der Zelle ein Verschwinden unsrer Körnchen, und erst später entstehen allerlei dunkle und granulöse Niederschläge.

Bei der enormen Hinfälligkeit und Vulnerabilität der frischen Sekretionszellen erwies es sich bald als unumgänglich nothwendig, der mechanischen Zerzupfung eine chemische Maceration und Härtung vorangehen zu lassen; noch lebenswarme Präparate gestatteten keinen tieferen Einblick in den Bau der Drüse, so sehr ich auch principiell für die Untersuchung der frischen Gewebe eingenommen, mich bemühte, die Anwendung von Agentien zu vermeiden. In erster Linie versuchte ich nun natürlich die Anwendung der nach Max Schultze's Vorgang in neuerer Zeit allen anderen Methoden vorgezogenen dünnen Lösungen der Chromsäure. So glänzend indess die Erfolge sind, welche dieselben an anderen Organen errungen haben, so wenig gelang es mir beim Pankreas mit ihrer Hülfe wesentlich weiter zu kommen. Auch das Jodserum entsprach nicht den gehegten Erwartungen. Sehr zu empfehlen ist dagegen die Müller'sche Flüssigkeit, obwohl bei längerer Einwirkung derselben das typische Bild der Sekretionszellen verwischt wird und überall körnige Niederschläge entstehen. Die Festigkeit indess, welche dies Agens den Zellen schon nach eintägigem Aufenthalt in demselben verleiht, gestattet eine sorgfältige Zerzupfung der Läppchen, ohne dass die Elemente derselben selbst zerstört werden.

Das Bild, welches man auf diese Weise nach vierundzwanzigstündiger bis dreitägiger Maceration in der angegebenen Flüssigkeit erhält, ist ein ziemlich buntes. Man lernt indess bald sich zurechtzufinden und kann dann folgende, theils überall sich findende, theils dem Pankreas eigenthümliche Gebilde unterscheiden:

1. Epithelzellen des Peritoneums, breite, platte Zellen mit grossem hellen Kerne; sie erscheinen, wenn sie auf einer Kante stehen, spindelförmig, mit sehr starker Prominenz des Kernes.

2. Bindegewebskörperchen, aus dem Mesenterium sowohl als auch aus dem Interstitialgewebe der Drüse, kleine granulirte Spindelzellen, die an den ausgebreiteten Theilen des Kaninchen-Pankreas nur spärlich vorhanden sind.

3. Blutgefässe und Bruchstücke derselben, d. h. gelegentlich Gruppen glatter Muskelzellen und Theile zerrissener und collabirter Capillaren, die eine sehr unregelmässige Gestalt besitzen können.

4. Blutzellen, sowohl rothe als weisse, letztere indess natürlich nur sehr selten.

5. Blasse, marklose Nervenfibrillen, meist zu feinen Stämmchen vereinigt und gelegentlich mit Ganglienzellen versehen.

6. wahre Sekretionszellen, polygonale Gebilde von den mannigfaltigsten Formen, sehr oft mit einem nicht selten ziemlich langen Fortsatze versehen. In einzelnen seltenen Fällen glaubte ich auch an den Kernen der Zellen einen Ausläufer wahrzunehmen, welcher nach dem Centrum der Läppchen gerichtet, in dem Körnchenhaufen dem Blicke entschwand und dem Kern ein den Kochfläschchen der Chemiker ähnliches Aussehen gab. Mehr als einen Kern in einer Zelle fand ich nur selten; einmal jedoch wiesen fast alle Zellen zwei Kerne auf. Es war dies in dem Pankreas eines jungen Hundes, der längere Zeit neuropathologischen Experimenten an der Medulla spinalis unterworfen worden war. Ob diese Kernvermehrung auf das Conto der Jugend des Thieres zu setzen, ob sie den besagten Experimenten zur Last zu legen ist, vermag ich natürlich aus einer so vereinzelten Beobachtung nicht zu entscheiden. Da ich jedoch an jungen Kaninchen nie in dieser auffallenden Häufigkeit zweikernige Zellen fand und andrerseits eine ähnliche Kernvermehrung nach Nervenreizung in der Glandula submaxillaris von Pflüger beobachtet worden ist, so neige ich mich mehr der zweiten Erklärungsmöglichkeit zu.

7. Epithelien der grösseren Ausführungsgänge, cylindrische Zellen mit grossem Kerne und nichtgranulirtem, homogenen Inhalt.

8. Spindelzellen ohne Körnchen mit einem grossen hellen Kerne, dessen Mitte feingranulirt ist; sie unterscheiden sich durch ihre scharfbegrenzte, meist ziemlich reine Spindelform und lange, homogene Ausläufer von allen anderen Zellen und liegen oft in bald kleinerer bald grösserer Anzahl balkenartig beieinander.

9. Kleine Zellen von meist ganz homogenem Inhalt und polygonaler Form mit rundem Kern ohne Kernkörperchen, meist zu zweien oder zu kleinen Gruppen beisammen liegend.

Unter dieser reichen Schaar verschiedener Zellformen sind es vor Allem die unter (8) erwähnten Spindelzellen, die durch ein ganz eigenthümliches Verhalten unsre Aufmerksamkeit in Anspruch nehmen. Denn während einzelne von ihnen frei herumliegend oder

schwimmend ihre eigenthümliche Form unbeschützt unsrem Blicke preisgeben, liegen andere inmitten eines bald nur aus zwei bis drei Zellen bestehenden, bald ein ganzes Läppchen repräsentirenden Häufleins von Sekretionszellen. Wieder andre Präparate endlich lassen einen continuirlichen Zusammenhang zwischen unseren Zellen und den wahren sekretorischen Elementen der Drüse unzweifelhaft erkennen, ein Zusammenhang, der durch eine ununterbrochene Verbindung des Ausläufers der Sekretionszelle mit einem Ausläufer der anderen Zelle hergestellt wird und die bekannten Proben des Herumwälzens etc. unter dem Mikroskope glänzend besteht. Aber nicht nur mit einer Sekretionszelle verbindet sich eine unsrer Zellen, vielmehr kann man an günstigen Präparaten zwei und noch mehr sekretorische Elemente mit ihr cohäriren sehen. Betrachtet man nun ein unzerzupftes Präparet einer eben so lange mit Müller'scher Flüssigkeit behandelten Bauchspeicheldrüse, so gelingt es auch hier leicht, fast in jedem Drüsenläppchen ein oder zwei, ja drei und vier von unseren Zellen im Centrum wahrzunehmen; der einzige Grund, weshalb man bei der frischen Drüse diese Gebilde nicht sieht, ist der sichere Schutz vor unseren Blicken, den ihnen die Körnchenhaufen der Sekretionszellen gewähren, ein Schutz, den die mehr gelockerten Verhältnisse nach Behandlung mit der Macerationsflüssigkeit vernichten.

Es liegt nun Nichts näher, als die Frage nach der Natur dieser centro-acinären Zellen, und an diese Frage schliesst sich die andere: nach ihren Beziehungen zu den Ausführungsgängen der Drüse, die doch allen zu Recht bestehenden Vorstellungen gamäss, eben an derselben Stelle, im Mittelpunkte der Läppchen beginnen sollen.

Dieser Frage kann man natürlich nur mit Injectionen beikommen. Der grössere Ausführungsgang der Bauchspeicheldrüse des Kaninchens mündet bekanntlich gesondert vom Ductus choledochus ungefähr sechs Centimeter unterhalb desselben in den Darm. Er ist ziemlich fein, kann indess mit dünnen Canülen, namentlich von Glas, oder noch bequemer mit der stumpf gewordenen Canüle einer Pravaz'schen Spritze wohl injicirt werden. Man öffnet zu diesem Zwecke den Darm an der, der Einmündungsstelle des Ganges gegenüberliegenden Stelle und breitet ihn über den Finger eines Assistenten. Die Einmündungsstelle des Ganges liegt in einem kleinen Schleimhautwulst, der uns bei dem angegebenen Verfahren sofort

entgegentritt; man muss ihn mit einem flachen Scheerenschnitte zum Theil fortnehmen, um den glänzend-weissen Gang sehen und die Canüle in ihn einführen zu können. Zu den Injectionen verwandte ich mit bestem Erfolg eine mit Glycerin gemischte Lösung von Berlinerblau. Gefärbte Leimlösungen waren meist unbrauchbar, gaben jedoch in einzelnen Fällen schöne Bilder. Asphaltlack mit Chloroform verdünnt versuchte ich sehr oft, meist mit gutem Erfolg, der jedoch zu den anderen Unannehmlichkeiten dieser Methode in keinem Verhältniss steht, zumal da die einfachste und bequemste Injectionsmasse vollkommen genügte. Auch Silberinjectionen machte ich vielfach; doch davon später. Die zu einer wenigstens stellenweise vollkommenen Injection erforderliche Menge von Flüssigkeit ist keine grosse. Drei bis vier Pravaz'schen Spritzen genügen hierzu.—Die injicirte Drüse wurde theils frisch, theils nach längerem Aufenthalt in Müller'scher Flüssigkeit untersucht.

Betrachtet man nun an einer soeben injicirten Drüse eine leicht blau gefärbte Stelle, so gewahrt man, dass überall der feine, in der Mitte des Körnchenbaumes befindliche Hohlraum mit Injectionsmasse erfüllt ist. Dieser Raum gehört also den Ausführungsgängen an. Aber der Anfang der Gänge fällt keineswegs zusammen mit dem Ende der Körnchenzeichnung. An gut und vollkommen injicirten Stellen kann man vielmehr leicht erkennen, dass die Injectionsmasse nicht nur die Mitte der Drüsenläppchen ausfüllt, sondern auch zwischen die einzelnen Zellen eingedrungen ist. Sie füllt hier zierliche birnförmige Räume, die durch einen kurzen, bald dickeren, bald feineren Stiel mit dem centralen Theile des Ganges zusammenhängen und ein wenig entfernt von der Membrana propria des Drüsenläppchens abgerundet enden. Diese Verhältnisse weichen vollkommen ab von dem, was man über das Verhältniss der Gänge zu den Zellen der acinösen Drüsen in den Handbüchern findet. In der neusten Auflage der Kölliker'schen Gewebelehre, p. 433, findet sich folgende Stelle:

"Auf jeden Fall sind die Gallencapillaren Intercellulargänge eigner Art, welche von den ächten Drüsenkanälen, die allerdings auch solche Gänge darstellen, dadurch sich unterscheiden, dass sie immer nur von einem kleinen Bruchtheil der gegen das Lumen gerichteten Zellen-

wand begrenzt werden und somit sehr eng sind. In jeder anderen Drüse ferner sind die Zellen stets nur mit Einer Wand an der Bildung der die Absonderung aufnehmenden Kanäle betheiligt, bei den Leberzellen dagegen gilt dies von allen Wandungen, mit Ausnahme derer, die an die Blutcapillaren grenzen, und giebt es keine andere Drüse, deren Elemente eine so vielfältige Beziehung zur Absonderung zeigen wie die Leber."

Die Bauchspeicheldrüse schliesst sich also in vielen Beziehungen vollkommen der Leber an. Die Anfänge der Ausführungsgänge sind drehrund und fein, sie berühren keineswegs die ganze ihnen zugewandte Fläche der Drüsenzellen, sondern nur einen Theil derselben. Dafür aber liegen die Zellen nicht nur mit Einer Wand den Gängen an, sondern stets mit mehreren, und es bleibt fast immer nur die eine der Membrana propria des Drüsenläppchens zugewandte Seite der Drüsenzelle frei von der Berührung der Ausführungsgänge. Diese aber bleibt es auch immer, und es gelang mir nie, wie Gianuzzi in der Submaxillaris, von den Gängen aus, zwischen die peripheren Zellenflächen und die Membrana propria des Drüsenläppchens Injectionsmasse einzutreiben, selbst nicht in den Fällen, in denen das vollkommene Misslingen der Injection die Anwendung eines zu starken Druckes bewies. In diesen Fällen waren, wie man an neben einander liegenden Läppchen sehen konnte, zuerst die kleinen birnförmigen Anfangsräume der Gänge über Gebühr angedehnt worden, so dass zwischen ihnen nur noch ein abnorm kleiner Zwischenraum übrig blieb, den der grosse Zellenkern ganz auszufüllen schien, und, wenn der Druck noch weiter zunahm, wurden diese Räume zersprengt and die Zellen selbst füllten sich mit Injectionsmasse. Ein blasenförmiges Abheben der Membrana propria des Drüsenläppchens fand niemals statt.

Zeigen somit die Anfänge der Ausführungsgänge eine wesentliche lokale Differenz von den bisher verbreiteten Vorstellungen, eine Differenz, die sicher für die feineren Vorgänge bei der Sekretion, für die engeren Beziehungen zwischen Zelle und Gang nicht ganz bedeutungslos sein kann, so werden wir andrerseits auch in der Struktur der Wandungen, auch formell eine nicht uninteressante Abweichung zu bemerken Gelegenheit haben. Während nämlich an den

übrigen Drüsen, mit denen hierin auch die Leber nach den neuesten Untersuchungen im Wesentlichen übereinstimmt, die Epithelzellen der gröberen Ausführungsgänge einfach von den sekretorischen Elementen abgelöst werden, die letzteren an die Stelle der Gangepithelien treten, der Uebergang zwischen beiden Zellformen durch einfache Substitution hergestellt wird, zeigt sich bei unserer Drüse ein wesentlich differentes Verhalten.

Die grösseren Ausführungsgänge besitzen ein regelmässiges Cylinderepithel, welches in einfacher Lage die Gänge auskleidet, und nach Aussen von einem fibrillenreichen, gefässführenden Bindegewebe umgeben wird. Die Zellen dieses Epithels zeigen einen Längendurchmesser von 0,013, einen queren von 0,008 Millimeter; ihre Kerne eine Länge von 0,008, eine Breite von 0,004 bis 0,005 Millim. In Rücksicht auf die von Pflüger an den Speichelgängen beobachteten eigenthümlichen Beziehungen der Nerven zu den Epithelien der Gänge untersuchte ich eine Menge von pankreatischen Gangepithelien frisch oder nach Maceration in Kalilösung und Chromsäure, vermochte indess ähnliche Einrichtungen nicht zu constatiren.

Von diesen grösseren Ausführungsgängen zweigen sich unter einem meist annähernd rechten Winkel kleinere Gänge ab, deren Zellen von dem relativ kleinzelligen Cylinderepithel der grossen Gänge wesentlich abweichen. Während ihre Breite eine nicht unbedeutende Zunahme erfährt, verlieren sie auffallend an Höhe, d. h. sie stellen nicht mehr ein gleichmässiges Cylinderepithel dar, sondern eine Art von Pflasterepithel, dessen Elemente jedoch nicht einfach polygonal sind, sondern nicht unähnlich gewissen Epithelformen aus den Venen, eine bald mehr, bald weniger unregelmässige Spindelform besitzen. Die Gänge mittleren Kalibers sind somit von spindelförmigen Zellen umgeben, deren grosse, helle Kerne nach Aussen etwas über den Contour des Ganges prominiren und demselben so ein unregelmässiges Aussehen geben, während das Lumen vollkommen regelmässig und überall drehrund ist. Die Kerne des Epithels zeigen einen grössten Durchmesser von 0,008 Millimeter, während die Länge der Zellen meist zwischen 0,024 und 0,032 schwankt, bisweilen jedoch auch die letztere Zahl noch übersteigt. In der Mitte des hellen Kernes findet sich ein spindelförmiges

Häufchen leicht granulirter Masse, während der Inhalt der Zelle selbst ein ganz homogener ist. Diese Zellen unterscheiden sich somit in Nichts von den oben erwähnten centro-acinären Zellen und die weitere Verfolgung der Gänge nach der Peripherie hin ergiebt dem entsprechend einen nahen Zusammenhang zwischen beiden.

Von diesen Gängen mittleren Kalibers zweigen sich endlich die feinsten Gänge ab, bei denen die Differenz zwischen dem äusseren Contour des Ganges und dem stets vollkommenen regelmässigen Lumen eine höchst auffallende wird. Der gleichmässig runden Injectionsmasse liegen in Anfangs kleinen, bald aber grösseren Abständen die eben beschriebenen Zellen an und bedingen so ein bald rosenkranzförmiges, bald ganz unregelmässiges Aussehen der Gänge. Die Zellen nehmen an Zahl rasch ab, und endlich scheint sich der Gang ganz von ihnen zu emancipiren. Er sendet seine birnförmigen Enden zwischen die einzelnen Sekretionszellen nur von einer ganz homogenen dünnen Membran umgeben, während die letzten der Spindelzellen im Centrum des Drüsenläppchens liegen bleiben, und scheinbar unabhängig von dem Ausführungsgang, ihre Verbindungen mit den Sekretionszellen eingehen.

Ein definitives und klares Urtheil über diese wirklich recht complicirten Verhältnisse vermochte ich mir indess, trotz manchen Versuches, nicht zu bilden. Eine Reihe von glücklichen Injectionen dünner Lösungen ($\frac{1}{4}$ bis 1%) von Argentum nitricum, welche ich zu diesem Zwecke unternahm, zeigte mir in den grösseren Gängen eine schöne und regelmässige Epithelzeichnung; in den mittleren war eine solche ebenfalls vorhanden, wenn auch, der veränderten Gestalt der Zellen entsprechend, weniger regelmässig, in den feineren Gängen jedoch, sowie in den Anfängen der Gänge fanden sich wohl allerlei unregelmässige wellige oder gerade Linien, aber ein Zusammenhang dieser mit den anliegenden Spindelzellen konnte nicht constatirt werden.

Während ich also einerseits, auch bei sehr starken Vergrösserungen, keine Betheiligung der centro-acinären Zellen an der Bildung der Enden, oder richtiger der Anfänge, des ausführenden Apparates entdecken konnte, vielmehr die wie es schien von einer zarten, homogenen Membran umgebene Injectionsmasse bald quer über die Zellen fortlaufen, bald deutlich neben ihnen liegen sah, lässt doch auf der

anderen Seite die vollkommene formale Uebereinstimmung dieser Zellen mit den Epithelien der Gänge zweiten und dritten Ranges, sowie die constante locale Zusammengehörigkeit dieser Zellen mit den Gängen, eine functionelle Trennung, wie mir scheint, nicht zu. Dazu kommt noch, dass sich der allerdings zweifellose Zusammenhang zwischen den secretorischen Elementen und den centro-acinären Zellen sehr gut erklären lässt, wenn man annimmt—und diese Annahme erscheint unabweisbar—dass die homogene Membran der birnförmigen Ganganfänge zusammenhängt mit unseren Zellen. Ist dann dies Anfangsstück des Ganges, ungetrennt von der Secretionszelle, der es zugehört, collabirt, so muss der Schein eines directen, substantiellen Zusammenhanges zwischen der centro-acinären und der Secretionszelle entstehen. Der Zusammenhang mehrerer Secretionszellen mit einem Exemplar der anderen Form würde zwar eine sehr complicirte Gestalt dieser letzteren voraussetzen, aber doch in keiner Weise gegen die gegebene Erklärung sprechen.

Möge nun aber diese Hypothese richtig sein oder nicht, das steht jedenfalls fest, dass wir im Pankreas keinen directen Uebergang der secretorischen Elemente in die Gangepithelien haben. Es drängen sich vielmehr diese centro-acinären Zellen als ein unbequemes Zwischenglied zwischen beide.

Es versteht sich bei dem jetzigen Genius epidemicus von selbst, dass ich Anfangs sehr geneigt war, in den centro-acinären Zellen die Enden eines nervösen Apparates zu sehen, um so mehr, als die Verhältnisse bei der Submaxillaris ähnliche zu sein scheinen. Tinctionsversuche, die ich zur Entscheidung dieser Frage anstellte, blieben vollkommen resultatlos. Dies ist indess ganz natürlich; denn das Goldchlorid zeigt bekanntlich zu den sekretorischen Zellen eine mindestens ebenso grosse Zuneigung, wie zu den marklosen Nervenfasern und den mit ihnen in Zusammenhang stehenden ganglionären Elementen, und von dem Carmin kann man ungefähr das Nämliche aussagen. Die Ueberosmiumsäure endlich liefert überhaupt nur von markhaltigen Nerven klare und beweisende Bilder und ihre Anwendung ergab, ausser dunkle schwarze Färbung der Körnchen der Sekretionszellen nur ein gleichmässiges Grau aller übrigen Elemente.

Ich erwähnte oben bei Gelegenheit der Beschreibung der mannigfaltigen Gebilde, welche die Zerzupfung eines mit Müller'scher

Flüssigkeit behandelten Pankreas liefert, unter (9) eine noch nicht näher besprochene Zellenform. Diese Zellen sind kleine unregelmässig polygonale Gebilde; ihr Inhalt is vollkommen homogen, glänzend und frei von irgendwelchen Körnchen, ihr Kern hell, rund, von mittlerer Grösse. Ihre Durchmesser betragen, 0,0096 bis 0,012 Millimeter, die des Kernes 0,0075 bis 0,008.

Diese Zellen liegen meist in grösserer Anzahl bei einander, eigenthümlich vertheilt im Parenchym der Drüse. Betrachtet man nämlich eine Bauchspeicheldrüse, die zwei bis drei Tage lang in Müller'scher Flüssigkeit gelegen hat, bei schwacher Vergrösserung, etwa System 4 von Hartnack, so bemerkt man regelmässig zerstreut in der Drüse rundliche, intensiver gelb gefärbte Flecke, and zwar ungefähr einen auf die Grösse eines Gesichtsfeldes bei Okular 3. Die Anwendung stärkerer Systeme ergiebt, dass diese Flecke ausschliesslich aus unseren Zellen bestehen. Diese sind also, zu rundlichen Häuflein geschaart, in regelmässigen Abständen im Parenchym (im alten Sinne des Wortes) der Drüse vertheilt. Ihre Häuflein zeigen meist einen Durchmesser von 0,1 bis 0,24 Millimeter, und sind ohne Mühe auch an Zerzupfungspräparaten, die von der ganz frischen oder kurze Zeit mit Jodserum behandelten Drüse angefertigt worden, wahrzunehmen. Sie zeigen dann, wie fast alle frisch untersuchten Zellen, eine vollkommen runde Gestalt, weichen aber sonst in Nichts von der oben gegebenen Beschreibung ab; ihr Inhalt zeigt also auch hier einen eigenthümlichen Glanz.

War nun die Antwort, die ich oben auf die Frage nach der Natur der centro-acinären Zellen zu geben vermochte, eine nur ungenügende und bedingte, so gilt dies leider in noch höherem Masse von der Art, wie ich die analoge Frage bei diesen Zellen zu beantworten im Stande bin. Denn oben konnte ich wenigstens mit einem gewissen Grade von Wahrscheinlichkeit eine bestimmte Ansicht formuliren: hier aber gestehe ich offen, dass mir jede Möglichkeit einer Erklärung fehlt. Ich kann nur einige weitere Beobachtungen beibringen, welche vielleicht auf das Vorhandensein gewisser Beziehungen zwischen unseren Zellen und dem nervösen Apparat der Drüse schliessen lassen. Einmal nämlich sieht man relativ häufig ein Stämmchen blasser Nerven über unsere Zellhäuflein hinwegziehen, jedoch ohne dass ich irgend eine Verbindung zwischen ihnen nach-

weisen konnte; ebenso liegen nicht ganz selten unsere Zellhäuflein in unmittelbarer Nachbarschaft eines Ganglion, ja in einzelnen Fällen scheinen sie in ähnlicher Weise dem Nervenstämmchen angelagert, wie dies bei schwachen Vergrösserungen mit den Ganglienzellenhaufen zu sein scheint. In zwei Fällen endlich war in einem kleinen Ganglion der Raum einer oder mehrerer Ganglienzellen von einem kleinen Zellenhäufchen eingenommen, dessen Elemente mit unseren Zellen eine auffallende Uebereinstimmung zeigten. Diese Beobachtungen sind indessen so unvollkommen und lückenhaft, dass ich mich selbst einer Hypothese über den Charakter und Werth unserer Zellen enthalten muss.

Ebenso unvollständig, wie über diesen Punkt, sind leider auch meine Beobachtungen über die Nerven der Bauchspeicheldrüse. Dieselben bestehen aus breiten und schmäleren Stämmchen von überwiegend marklosen Fasern. Sehr selten nur findet man in den breitesten Stämmchen beim Kaninchen eine doppelt contourirte, markhaltige Faser, während dies in dem Pankreas der Katze weit häufiger der Fall ist. Sehr gross dagegen ist die Zahl der Ganglien, mit denen die Nervenstämme in Verbindung stehen. Sie zeigen eine sehr verschiedene Grösse und dem entsprechend eine grosse Mannigfaltigkeit in Hinsicht der Zahl ihrer Elemente; ich fand im Minimum zwei, im Maximum über fünfzig Ganglienzellen zu einem Ganglion vereint. Die grössten Anhäufungen zeigten eine Länge von 0,32 Millimeter, die meisten eine solche zwischen 0,1 und 0,24, während die Zellen constant einen Durchmesser von 0,025, ihre Kerne einen solchen von 0,0096 Millimeter besitzen. Diese Zellen unterscheiden sich also, wie es scheint, nicht von denen der allerdings viel selteneren und an Zahl der Elemente tief unter ihnen stehenden Ganglien, die man an den blassen Nervenstämmen des Mesenteriums findet. Die Ganglien des Pankreas liegen mit Vorliebe zwischen grösseren Häufchen von Drüsenläppchen, doch findet man sie auch, analog den oben besprochenen Zellhaufen, mitten in einem Haufen feinster Läppchen.— Alle Versuche, feineren Verzweigungen der marklosen Nervenfasern mit Tinctionen, namentlich mit Goldchlorid, beizukommen, scheiterten an der stets sehr intensiven Färbung der sekretorischen Elemente, bei denen bald der Kern, bald der Zellinhalt eine hellere Nüancirung der Gold-Röthe darbot, und nicht selten die zufällig angefüllten Anfänge

der Ausführungsgänge schön zu sehen waren. Ebensowenig führten Versuche mit Chlorgoldkalium zum Ziele, ebensowenig Zerzupfungen.—Dass die Gefässe, namentlich die Arterien, von reichlichen Geflechten blasser Fasern umsponnen sind, bedarf, als selbstverständlich, wohl kaum der Erwähnung.

Mit demselben Resultate, welches Zerzupfungsversuche behufs Nervenverfolgung ergaben, versuchte ich, die Lymphgefässe der Bauchspeicheldrüse zu injiciren. Während der grosse Ausführungsgang des Kaninchenpankreas in den aufsteigenden Schenkel der ersten Dünndarmsschlinge einmündet, findet sich an der tiefsten Stelle derselben, unmittelbar neben dem am meisten nach unten reichenden Theile der Drüse sehr oft eine vereinzelte Lymphdrüse, von der ich hoffte, dass sie nähere Beziehungen zu den Lymphgefässen meines Objectes haben möge. Wenn indess schon das gelegentliche Fehlen der Drüse hiergegen sprach, so ist dies ebenso der Fall mit der vollkommenen Erfolglosigkeit aller Versuche, mit der Einstichsmethode eine Injection der betreffenden Lymphbahnen zu erreichen, obgleich wohl die Ungeübtheit in diesem Theile der mikroskopischen Technik die Hauptschuld am Misslingen der wenig zahlreichen Versuche trug.

Zum Schluss will ich noch einige Versuche erwähnen, die Secretion und etwa sichtbare Vorgänge bei derselben am lebenden Thiere zu beobachten, Versuche, die zwar ebenfalls von vollkommen negativem Resultat gekrönt wurden, aber vielleicht unter günstigeren Umständen von einem glücklicheren Beobachter wieder aufgenommen, unsere Kenntnisse von der Art des Geschehens der feineren Vorgänge im Organismus wesentlich fördern können. Die Idee selbst, die Secretion am lebenden Object direkt zu verfolgen, lag für uns im pathologischen Institute damals sehr nahe. Waren wir doch Ohren- und zum Theil auch Augenzeugen gewesen von dem glänzenden Erfolge, mit dem Cohnheim damals die Beobachtung des lebenden Thieres anstellte! Anders war es allerdings mit den technischen Schwierigkeiten. Bei dem vollkommenen Mangel an geeigneten Vorrichtungen, um ein Kaninchenpankreas mit leidlicher Aussicht auf Erhaltung des Lebens längere Zeit beobachten zu können, musste ich von vorn herein auf dies so überaus günstige Object verzichten und auf die Kaltblüter recurriren. Nun ist zwar beim gewöhnlichen Triton ein Theil der

Bauchspeicheldrüse ebenso flächenhaft ausgebreitet, wie beim Kaninchen, und dieser Theil kann bei einiger Uebung ohne bedeutende Störungen des Kreislaufes unter das Mikroskop gebracht und selbst mit Immersionssystemen stundenlang beobachtet werden, indess der mangelnde Erfolg dieser Beobachtungen kann bei den höchst unordentlichen Verdauungsverhältnissen des Kaltblüters, ebensowohl auf ein gänzliches Fehlen der Sekretion zur Zeit der Untersuchung, als auf einen Mangel sichtbarer Veränderungen bei derselben bezogen werden. Ich versuchte die Beobachtung sowohl beim curarisirten Triton, als beim chloroformirten und nicht betäubten. Man kann durch die Befestigung der Füsse des Thieres an einigen, in passender Entfernung auf einer Glasplatte befestigten Korkstückchen leicht die dringend nöthige Immobilisirung des untersuchten Objectes erreichen. Indess auch diese Ruhe nützte mir nichts. Die Körnchen der Sekretionszellen, auf die ich bei ihrer eigenthümlichen Lagerung an den Gängen meine ganze Hoffnung gesetzt hatte, waren zwar ausgezeichnet schön zu sehen, schimmernd in dem gelblichen Glanze, den sie an der frischen Drüse fast immer zeigen, aber eine Bewegung konnte ich trotz des besten Willens weder an ihnen, noch sonst wo in der Zelle wahrnehmen, ein Resultat, das indess, wie ich hier nochmals hervorheben will, keinerlei Schlüsse gestattet auf das Verhalten all dieser Theile bei lebhafter Sekretion.

Sollte etwa Jemand diese Versuche wiederholen wollen, so sei für ihn bemerkt, dass man den Haut und Muskelschnitt beim Triton am besten auf der linken Seite des Thieres macht und zwar entsprechend dem mittleren Drittheil der Entfernung zwischen der oberen und unteren Extremität. Es gelingt dann leicht die Pankreas haltende Darmschlinge zu finden und durch Befestigung des Darmes auf einem Korkstreifen, welcher ein Glasstückchen umgiebt, in einer für die Beobachtung geeigneten Weise zu fixiren. Der Blutverlust, der bei diesen vorbereitenden Operationen eintritt, ist bei einiger Uebung nur ein sehr geringer, und dem entsprechend zeigt sich auch der Kreislauf in der Drüse in keiner Weise gestört und kann lange beobachtet werden.

# CONTRIBUTIONS TO THE MICROSCOPIC ANATOMY OF THE PANCREAS.

INAUGURAL-DISSERTATION

FOR THE DOCTOR'S DEGREE IN

MEDICINE AND SURGERY

PRESENTED TO THE MEDICAL FACULTY

FRIEDRICH-WILHELMS-UNIVERSITY

BERLIN

AND TO DEFEND PUBLICLY ON

FEBRUARY 18, 1869

BY PAUL LANGERHANS

BERLIN.

In the summer of 1867 I began at the Berlin Pathological Institute, through the kindness of Professor Virchow, a series of investigations on the finer structure of the pancreas; in this I was assisted with advice and material in a most friendly manner by Dr. W. Kühne, then First Assistant in the Pathological Institute, now Professor of Physiology at Amsterdam. In the fall of the same year, due to external circumstances, I was forced to leave my task temporarily and could not resume it till October 1868, without, however, being able to make any appreciable headway. A confirmation of what had already been established was the only result of this attempt.

The only reason for relating the development of my work is to apologize for its scanty contents. With regret, I must open my communication with the declaration that I cannot in any way put forth the conclusive results of a completed investigation. I can describe, at most, a few isolated observations which suggest a much more complicated structure of the organ investigated than hitherto accepted. The purpose of these lines can therefore at best only be to help draw greater attention to the pancreas than has hitherto been given to it by anatomists.

There is indeed hardly another organ in which there is such glaring contrast between the brilliant results of physiologic research and the complete darkness in the realm of anatomic knowledge. Practically all that receives any thorough consideration from the anatomic point of view is the relationship of this gland to the peritoneum or whether the opening of this or that excretory duct is at a higher or lower level. As to the structure of the gland I did not succeed in finding in text-books anything other than the statement that the pancreas is a racemose gland which generally contains a mass of infiltrating fat. In Claude Bernard's "Mémoire sur le Pancréas" there is a very fine reproduction of a gland lobule with the remark that there are many nuclei in the pancreas. Nevertheless the blood supply of the gland is well known, and it is in fact entirely impossible to inject a few ounces of colored fluid into the aorta of an animal without bringing out most beautifully the delicate vascular loops of the pancreas. An injection of the pancreatic duct, as far as I could survey the literature, had not yet been done. These rather incomplete observations justify a more thorough description; and I apologize, should these lines fall into the hands of an experienced microscopist, and should he find in it a little too much of the known, and much too little of the unknown.

I investigated first of all, and almost exclusively, the pancreas of the rabbit, which of all the animals commonly at our disposal in the laboratory possesses a pancreas with a structure most favorable for investigation. It is in large measure spread out flat between the layers of the mesentery and in such thin laminae that portions taken out with scissors without any further preparations are ready for microscopic observation. This holds true likewise with small portions of the pancreas of the salamander; whereas the pancreas of man, the guinea pig, dog, cat, pigeon, snake, frog, and hen is very compact and not favorable for observation.

Now, if a portion of the warm pancreas, taken from a rabbit just killed, is observed under low power in a neutral liquid medium, in the great majority of cases not a trace of the nuclei is found. Nothing is seen but a fine sketch not unlike the branches of a defoliated tree, built up mostly of fine, faintly yellow refractile granules. This granular tree branches out most delicately and discloses

a simple stem through the center of the terminal lobule hemmed in by a vascular network. If this stem is examined under higher power it is easily discernible that it is not a solid structure, but on the contrary it shows throughout a very fine central canal. This fine white canal surrounded by a rich mass of minute granules is continuous with the larger excretory ducts of the gland, discernible without further technical assistance, and each injection shows that it belongs without doubt to the system of excretory passages. Close to this granular tree-like duct system, between the lumen and the basement membrane of the lobule there appear sooner or later the nuclei of the secreting cells in a single row, one next to the other,—large, bright vesicles often containing a brilliant nucleolus and covered not infrequently on the side facing the periphery of the lobule with a hood of dark granules, seldom more than ten. If a piece of fresh gland is teased apart it is easy to establish that the granules which are located centrally about the lumen belong to the gland cells, the true secretory cells. These granular particles are round in the very fresh cells, and polygonally angular in the semi-coagulated cells; in size they approximate the nucleus, i. e. about 0.0064 mm. in diameter, while the cells themselves are 0.016—0.024 mm. in diameter. Thus there can be differentiated three zones in the secretory cells of the pancreas, about equal in size; the centro-acinar granular zone, the zone of nuclei, and finally the peripheral zone, which, in most of the cases, in fresh preparations is perfectly homogeneous and transparent, containing not very rarely the few above-mentioned granules, and somewhat smaller than the other parts of the cell. The finer structure of the pancreatic cells is therefore very characteristic; it shows important variation from the structure of other secretory elements and makes possible an exact differentiation of our cells from similar tissues,—an isolated fact as far as I know. This holds true not only for the pancreas of the rabbit but in very much the same way for all the above-mentioned animals, namely, the frog, salamander, pigeon, hen, dog, cat, guinea-pig, and man. The reptile alone is an exception; at least, I found an example among them, in which not an insignificant number of cells were completely filled with the above-mentioned granules without a regular arrangement. The granules of the secretory cells are undoubtedly

identical with those mentioned in all text-books as fat and really seem to be nothing but fat. They show an active molecular motility when the fresh cells are mechanically destroyed and give, when treated with supersaturated osmic acid, the deep black staining of fat. They also dissolve in caustic potash of moderately high concentration, in ether, and in chloroform. When dissolved in the latter there immediately appears in the cells a granular precipitation, while our granules become paler and paler, finally to disappear entirely. Treating the cells with caustic potash, on the contrary, causes the disappearance of our granules, as the cells go through recurrent swelling, and only later there develops a dark and granular precipitation.

With the marked instability and vulnerability of fresh secretory cells it soon becomes evident that it is absolutely necessary to precede the mechanical tearing apart by a chemical maceration and hardening; desiring to employ principally fresh tissues for investigation, because nothing gives a deeper insight of the structure of the gland, I endeavored to avoid the use of reagents. First of all I attempted naturally the use of Max Schultze's recent process of dilute solutions of chromic acid. Though the results were brilliant when these were used in other organs, I, nevertheless, could not accomplish anything important with them. Neither did iodized serum produce the anticipated results. However, Müller's fluid had much to recommend it, although with its prolonged use the typical picture of the secretory cells was obliterated and everywhere there occurred a granular precipitation. The firmness which this reagent gave to the cells, even in one day, made possible a careful tearing apart of the lobules without destroying their elements.

The picture obtained by macerating the gland in this fluid from twenty to seventy-two hours was at first confusing. However, one learns soon to orient himself and can then differentiate the following structures in part found everywhere, in part characteristic of the pancreas:

1. Epithelial cells of the peritoneum, broad, flat cells with large distinct nuclei; they look spindle-shaped when they stand on edge, with the nuclei very distinct.

2. Connective tissue cells, from the mesentery as well as from the

connective tissue of the gland, small granular spindle cells which are but scanty in the thin parts of the rabbit's pancreas.

3. Blood vessels and fragments of the same, i. e. occasional groups of flat muscle cells and parts of torn and mangled capillaries, which give a very irregular appearance.

4. Blood cells, red as well as white,—the latter naturally seen only very rarely.

5. Pale, nonmedullated nerve fibers mostly attached to fine trunks, occasionally mistaken for ganglion cells.

6. True gland cells, of manifold polygonal form, very often possessing a pretty long process. In a few isolated instances I thought that the nucleus of these cells, devoid of granules, also had an off-shoot directed to the center of the lobule giving it the appearance of a chemist's flask. Only seldom did I find more than one nucleus in a cell. Once, however, almost all the cells showed two nuclei. This was in the pancreas of a young dog that was subjected for a long time to neurological experiments on the medulla. Whether this nuclear proliferation can be attributed to the youth of the animal, or to the above-mentioned experiments I am not able of course to decide in such an isolated observation. Because I didn't find these double-nucleated cells in young rabbits frequently and as such a multiplication of nuclei was observed after nerve stimulation in the submaxillary gland by Pflüger, I am inclined to the latter explanation.

7. Epithelial cells of the larger ducts,—cylindrical cells with large nuclei and with homogeneous content, devoid of granules.

8. Spindle cells without granules with a large distinct nucleus the center of which is finely granular; they are differentiated from all other cells by their sharply defined almost perfect spindle-shaped form with a long homogeneous off-shoot, and lie together often in smaller or larger numbers like trabeculae.

9. Small cells of almost perfect homogeneous content, and of polygonal form, with round nuclei without nucleoli, mostly lying together in twos or in small groups.

In this rich multitude of miscellaneous cells it is first of all the spindle cells described in (8) which attracted our attention because of their very peculiar behavior. For while a few of them lie or roll

about freely preserving their characteristic shape, others lie in the center of groups of two or three or even of a whole lobule of secreting cells. In some preparations a direct relationship can be recognized between our cells and the secretory elements of the gland through the blending of their processes, a relationship confirmed when the fragments are seen rolling under the microscope. But our cells do not unite with one secretory cell only, more often in favorable preparations two or even more secretory elements may be seen coherent with one of them. Now if an unfragmented preparation of pancreas is treated in Müller's fluid it is easy to observe in each lobule one or two or even three or four of our cells in the center; the only reason why this picture is not seen in the fresh gland is that it is masked by the granules of the secretory cells, a condition eliminated in the macerating process.

Next comes the question as to the nature of these centro-acinar cells and this question is followed by another: their relation to the excretory ducts of the gland which should begin in the same place in the center of the lobule.

This question can naturally be answered only by injection experiments. The larger duct of the rabbit's pancreas, as is known, opens independently of the cholecystic duct about six cm. lower down in the intestine. It is very fine but can be well injected with a thin glass canula or better still with the blunt canula of a Prava syringe. For this purpose the intestine is opened at the spot overlying the orifice of the duct and it is spread out over the finger of an assistant. This orifice lies in a slight elevation of the mucosa, easily found with experience; this must be superficially cut in order to expose the intensely white duct, so that the canula may be introduced. For injection I used with best success a solution of Berlin blue mixed with glycerine. Stained gelatine solutions were generally useless; still isolated cases gave fine pictures. Asphaltlack diluted with chloroform I tried very often,—generally with good success, but not commensurate with other inconveniences of this method, as the simplest injection-substances sufficed. I also made silver injections; but of this, later. The amount of fluid necessary for complete injection was not large, at least in some places. Three or four Prava syringes were enough. The injected gland was examined in part fresh, and in part after fairly long stay in Müller's fluid.

If now in a gland so injected an area stained light blue is examined it becomes apparent that the fine canal in the middle of the granular tree is filled with the injection substance. This canal, then, is part of the excretory duct system. But the beginning of this system does not coincide in any way with the end of this canal. In well and completely injected places one can recognize more easily that the injection substance fills not only the center of the glandular lobule, but also penetrates between the individual cells. It fills here delicate pear-shaped spaces which are connected with the central portion of the ducts by short stalks of varying caliber and end bluntly not far from the basement membrane of the lobule. This differs completely from what is found in the text-books on the relationship of ducts to cells in acinar glands. In the latest edition of Kölliker's Histology, page 433, there is found the following passage:

"At any rate the bile capillaries are intercellular ducts of a peculiar sort and differ from ordinary ducts of which they take the place in that they are always formed by a small fraction of the cellular wall directed toward the lumen, and, therefore, are very narrow. In every other gland the cells take part in the formation of excretory ducts with only one of their walls, but in the case of the liver cells, they do so with all walls, except those bounding the blood capillaries, and there is no other gland the elements of which on so many sides are concerned in discharging secretion as those in the liver."

The pancreas therefore groups itself completely in many respects with the liver. The beginning of the ducts is circular and narrow and comes in contact with the secreting cells only through a limited portion of their walls. On the other hand, these cells come in contact with intercellular passages with their entire surface except the portion adjoining the membrana propria of the lobule. This is a constant finding and I never succeeded, as did Gianuzzi in the submaxillary gland, in forcing injection-fluid through the ducts between the cells and the basement membrane of the lobule, not even in the cases where through an error in the injection there was employed too great pressure. In such cases, as could be seen in nearby lobules, at first the small intercellular pear-shaped spaces were unusually distended, with only an abnormally small interspace remaining between them which

the large nuclei semed to fill completely; and if the pressure was still further increased, these spaces burst and the cells themselves were filled with injection-substance. A separation of the membrana propria of the lobule never took place.

Just as the beginnings of the excretory ducts show an important local variation from that generally described hitherto, a difference which surely cannot be entirely meaningless for the finer processes of secretion and for the more special relationship between cells and duct, so there is also an opportunity to observe formally not an uninteresting deviation in the structure of the duct walls. While in other glands,—and according to the newest investigations the same holds true to an important degree in the case of the liver,—the epithelial cells of the larger ducts are derived simply from the secretory elements, the latter taking the place of duct epithelium, the transition between both cell forms taking place through mere substitution, in our gland there seems to be a distinctly different relationship.

The larger excretory ducts possess a uniform cylindrical epithelium which lines the ducts in a simple way, and are surrounded externally by a connective tissue rich in fibrils and blood vessels. The cells of this epithelium show a long diameter of 0.013 and a transverse one of 0.008 mm.; their nuclei are 0.008 long by 0.004-0.005 mm. wide. Because of the observation of Pflüger in the salivary glands on the intimate relationship of nerves to duct epithelium I investigated the epithelium of a number of pancreatic ducts fresh and after maceration in potash and in chromic acid, but I could not disclose any similar arrangement.

From these larger ducts there branch out almost at right angles small ducts the cells of which differ distinctly from the relatively small cylindrical epithelium of the larger ducts. While they show not an inconsiderable increase in width they lose definitely in height, i. e. they do not any longer present a uniform cylindrical epithelium but a sort of pavement epithelium with the cells not polygonal, but not unlike certain epithelial forms of veins, possessing a more or less irregular spindle-shape. The ducts of medium caliber are thus lined with spindle-shaped cells with large, distinct bulging nuclei, giving these ducts an irregular appearance while the lumen is per-

fectly round everywhere. The nuclei of the epithelial cells show a maximum diameter of 0.008 mm. while the length of the cells varies mostly between 0.024–0.032, at times larger even than the last figure. In the center of the bright nuclei there is found a spindle-shaped mass of granular material, while the content of the cell itself is very homogeneous. These cells differ thus in no way from the above mentioned centro-acinar cells and the further course of the ducts to the periphery shows a close connection between the two.

From these passages of medium caliber there finally branch off the finest ducts in which the difference between the contour of the ducts and the uniformly perfectly regular lumen is most apparent. The round injection masses lie at first in the small, but soon in the larger spaces between the above-described cells and thus give now a rosette and now an irregular appearance to the passages. The cells diminish in numbers, and finally it seems that the duct is entirely free of them. It sends its pear-shaped ends between the individual secretory cells surrounded only by a very uniformly thin membrane, while the last of the spindle cells remain in the center of the gland lobules, and are apparently independent of the ducts in their relationship with the secretory cells.

I am not able to propose, in spite of many attempts, a definite and clear opinion over this truly very complicated relationship. A series of favorable injections of thin solutions (¼ of 1%) of silver nitrate, which I undertook for this purpose, disclosed in the larger ducts a beautiful, regular epithelium; in the medium-sized ones there was a similar epithelium, even though less regular, considering the changed appearance of the cells; but in the finer ducts, as well as at their beginnings there were found all kinds of irregular undulating or straight lines, but a connection between these and the adjoining spindle cells could not be demonstrated.

While, therefore, on the one hand I could not discover even under very high power that the centro-acinar cells took part in the building of the end, or more correctly, of the beginning of the duct apparatus, more than that it appeared to continue from an injection mass surrounded by a delicate homogeneous membrane at times extending across the cells, and at times lying clearly near them,—still it appears to me that the perfectly clear resemblance between these cells and

the epithelium of the ducts of the second and third degree as well as the constant local continuity of these cells with the ducts do not permit a functional dissociation. Furthermore, the undoubted relation between the secretory elements and the centro-acinar cells is well explained, when one accepts, and this seems irrefutable, that the homogeneous membrane of the pear-shaped duct openings are connected with our cells. If this beginning of the duct, unbroken from its gland cells, to which it belongs, collaborates, so it must be accepted that there is a direct definite connection between the centro-acinar cells and the secretory cells. The relationship of many secretory cells with a representative of other forms brings forth a very complicated appearance, but still does not speak in any way against the proposed explanation.

Be this hypothesis true or not, still it holds true in any case, that in the pancreas we have no direct transition between the secreting cells and the duct epithelium. Moreover, the centro-acinar cells force themselves as an uncomfortable intruder between them.

It is conceivable, in the present epidemic of genius, how at first I was much inclined to see in the centro-acinar cells the ends of a nervous apparatus, the more so, as in the submaxillary gland there seems to be a similar relationship. Staining experiments that I employed for the solving of this problem remain absolutely without results. This is naturally so; for gold chloride, it is known, shows at least as great an affinity for the secretory cells as for non-medulated nerve fibers and their related ganglionic elements, and the same may be said of carmine. Finally, the saturated solution of osmic acid gives a clear and demonstrative picture of medulated nerve fibers and, aside from the deep black staining of the granules of secretory cells, it gives only a uniform gray to all the other elements.

I mentioned above when describing the varied structure which the pancreas shows, when teased apart after being kept in Müller's solution, under (9) a cell form not yet closely described. This cell is a small irregularly-polygonal structure. Its cytoplasm is perfectly brilliant and free of any granules, its nucleus distinct, round, and of moderate size. Its diameter is between 0.0096-0.012 mm. and that of its nucleus 0.0075-0.008 mm.

These cells lie together generally in considerable numbers scattered diffusely in the parenchyma of the gland. If one observes under low magnification, about system 4 of Hartnack, a pancreas which was kept two to three days in Müller's solution one notices regularly scattered through the gland rounded spots stained intensely yellow about the size of the field of vision with ocular 3. Under higher magnification these spots are seen to consist entirely of our cells. These are massed together in rounded groups distributed at regular distances in the parenchyma (in the old sense of the word). These masses show generally a diameter of 0.1-0.24 mm. and can be discerned without difficulty in the fragmented preparations of fresh glands, or those treated for a short time with iodized serum. They show then, as do all cells seen fresh, an entirely red appearance, but do not deviate in any way from the above description; their content shows also here a characteristic brilliance.

If the answer I was able to give above to the question as to the nature of the centro-acinar cells was unsatisfying and conditional, so unfortunately am I unable even to a greater degree to answer a similar question in regard to these cells. For above I could at least with some degree of certainty formulate a definite opinion; but here I admit frankly I have no possible explanation. I can only bring forth several more observations which may possibly allow some speculation as to some relationship between our cells and the nervous system of the gland. First, fairly frequently a pale nerve fiber is seen coursing over our cell groups without any apparent connection between them; again, our cell groups, not very seldom, lie in immediate apposition to a ganglion; in some cases even, they seem in like manner to adjoin the nerve stem. In two instances, finally, the space of one or more ganglion cells was replaced by a small clump of cells which showed striking resemblance to our cells. These observations are, however, so incomplete and fragmentary that I must refrain from making any hypothesis as to the nature and significance of our cells.

Just as incomplete, as on this point, are also unfortunately my observations on the nerves of the pancreas. These consist of broad and narrow stems of undulating nonmedullated fibers. Only infrequently there is found in the largest nerve cords of the rabbit's

pancreas a double-contoured medulated fiber; this is more frequent in the pancreas of the cat. Very large, on the contrary, is the number of ganglia with which the nerve stems are connected. They show a marked variation in the size and number of ganglia with which the nerve stems are connected. They show a marked variation in the size and number of their elements; I found a minimum of two, a maximum of over fifty ganglion cells belonging to a ganglion. The largest aggregations showed a length of 0.32 mm., averaging 0.1-0.24; the cells showed constantly a diameter of 0.025,—their nuclei 0.0096 mm. These ganglion cells do not differ, therefore, in frequency and in number of elements from those found with the pale nerves of the mesentery. The ganglia of the pancreas lie with predilection between the larger masses of gland lobules, still they are also found like the above-mentioned cell clumps in the center of a group of the smallest lobules. All attempts to obtain finer branches of non-medulated nerve fibers with stains, namely with gold chloride, were shattered by the constant intense staining of the secretory elements, in which now the nucleus, now the cell cytoplasm offers a more distinct shading with gold red, and not rarely the accidentally filled openings of the ducts are nicely visible. Just as little did experiments with gold chloride potassium yield,—and just as little the fragmented preparations. That the blood vessels, especially the arteries are entwined by rich plexusses of pale fibers need, it is understood, hardly any mention.

The results were the same when in like manner I attempted to inject the lymphatics of the pancreas. Where the large duct of the rabbit's pancreas joins the ascending peduncle of the mesentery near its deepest portion and near the inferior surface of the gland there is often found a single lymph node which I hoped might have a close relationship to the lymphatic system. If the occasional absence of this lymph node spoke against it, the more so did the complete failure of all efforts to reach with an injection by the puncture method the related lymphatic channels; though the lack of skill in this field of microscopic technique is the chief cause of failure in my few efforts.

In conclusion I wish to mention several experiments for observing secretion and some of its visible phenomena in the living animal, experiments which though crowned with completely negative results,

still perhaps under more favorable conditions undertaken by a more fortunate observer may advance our knowledge of the origin of the finer functions in the organism. The idea, as such, to follow directly secretion in living animals, was then called to our attention in the Pathological Institute. We were witnesses to the brilliant success with which Cohnheim instituted observation in living animals. It was only a matter of technical difficulty. In my lack of preparation to observe over any length of time the pancreas of a rabbit kept barely alive, I had to retreat from this very worthwhile object, and to return to cold-blooded animals. Now in the salamander ordinarily a portion of the pancreas is just as flat as in the rabbit and this portion can be brought under the microscope with some practice without appreciable disturbance of the circulation and can be observed with the immersion system for hours at a time; lack of success in these observations may be attributed to the unusual digestion relationships in cold-blooded animals, or to an entire absence of secretions at the time of investigation, or to invisible manifestations of the same. I tried observation in curarized salamanders as well as in chloroformed and stunned ones. It is possible by tying the limbs of the animal on pieces of cork fastened at suitable distances to a glass plate to attain easily the important immobilization of the object under investigation. But even this fixation did not yield me any results. The granules of the secretory cells, on the specific position of which in the ducts I laid my entire hope, were even exquisitely beautifully visible, glistening in the yellow radiance, for they show always in the fresh gland, but I could not draw a conclusion as to the relation of all these parts in living secretion, as I had wished before, as to whether the motion resulted from them or from any other part of the cell.

Should any one wish to repeat these experiments, let it be noted that it is best to cut into the skin and muscle of the salamander on its left side on the middle third between the upper and lower extremities. It is possible then easily to find the mesentery holding the pancreas, and by attaching the gut on a strip of cork which surrounds a glass rod it is fixed in a favorable position for observation. The loss of blood, involved in these preparatory operations, is with some experience, very negligible and the circulation of the gland is in no way disturbed and can be observed for long periods.